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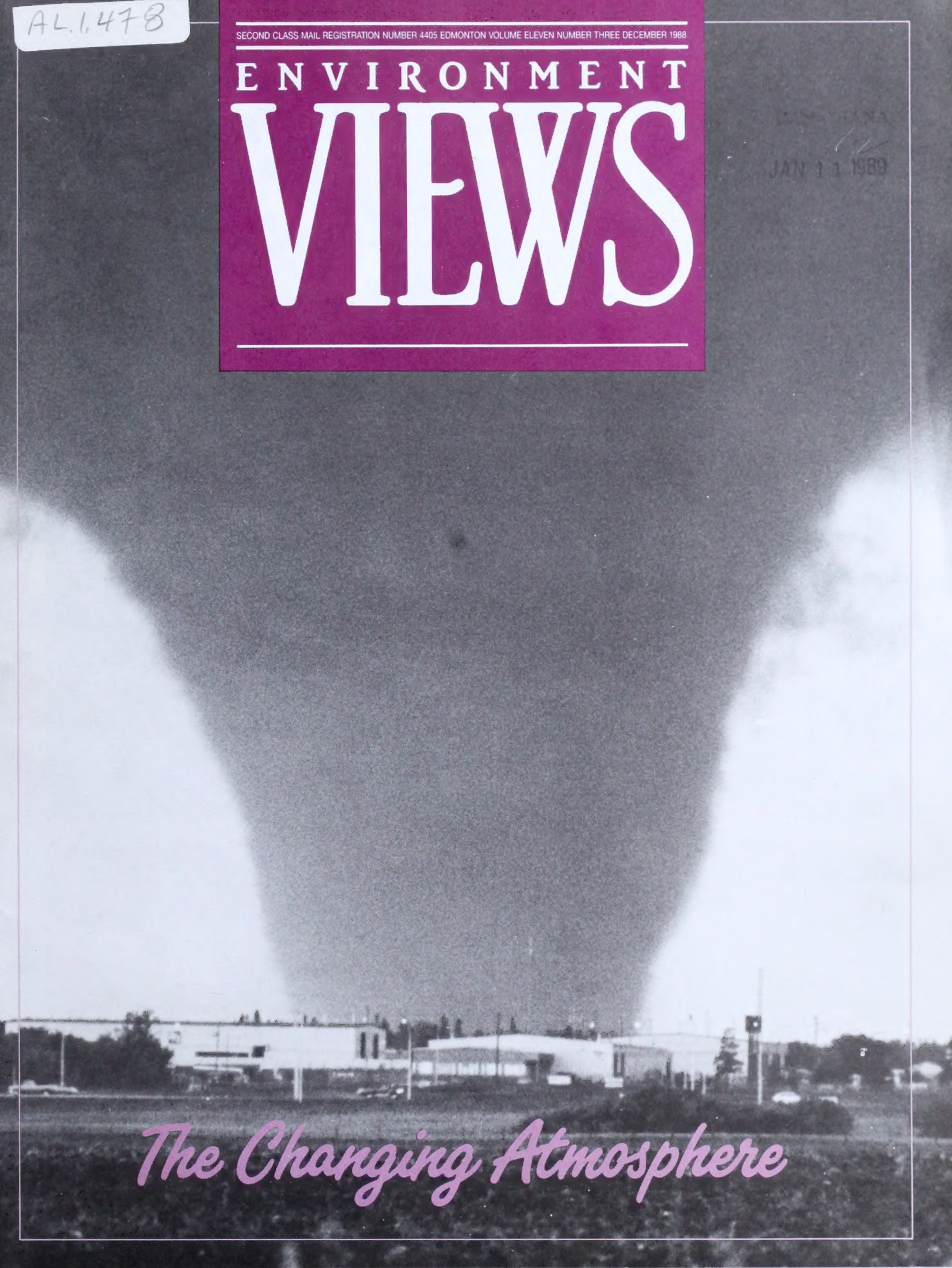
SECOND CLASS MAIL REGISTRATION NUMBER 4405 EDMONTON VOLUME ELEVEN NUMBER THREE DECEMBER 1988

ENVIRONMENT VIEWS

JAN 11 1989



The Changing Atmosphere

ENVIRONMENT
VIEWS

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The Edmonton Journal

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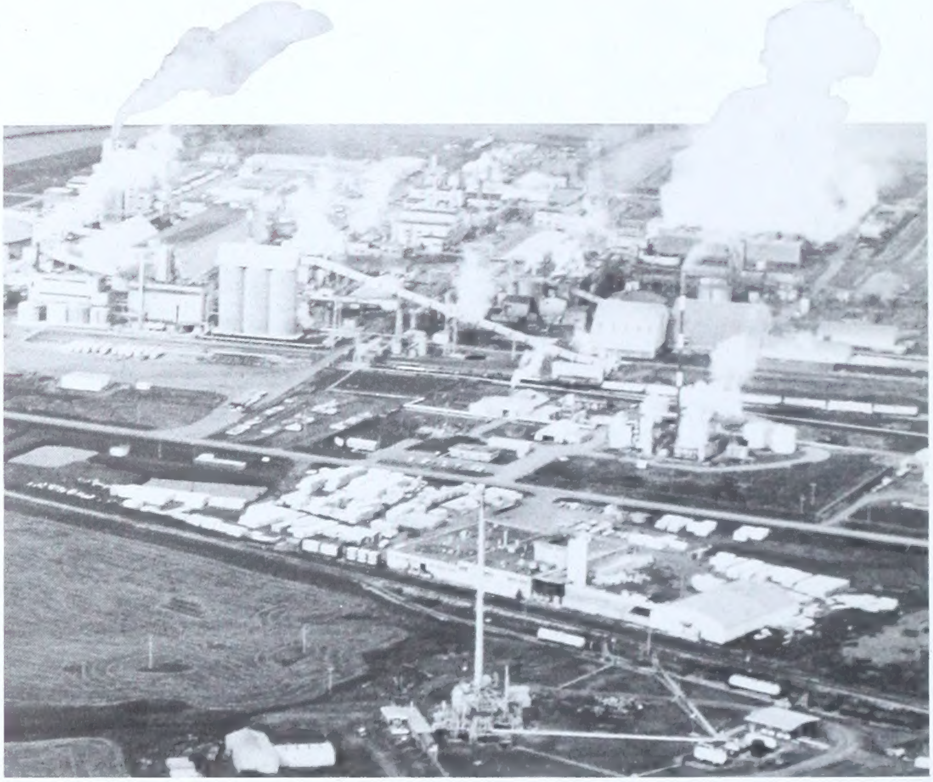

Environment Views is published quarterly by Alberta Environment. Each issue deals with a specific topic from various viewpoints with the aim of increasing awareness of environmental issues among Albertans. *Environment Views* is directed by an independent board with representation from environmental groups, government and industry. The views expressed by the publication are not necessarily those of Alberta Environment.

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Alberta
ENVIRONMENT

EDITOR'S NOTEBOOK

Atmospheric Change

"Humankind is conducting an unintended, uncontrolled and globally pervasive experiment whose ultimate consequences could be second only to a global nuclear war."

So begins the summary of the conclusions reached by the 300 scientists and policy makers (including heads of state) who assembled for the World Conference on The Changing Atmosphere: Implications for Global Security, held in Toronto last June. There's more:

"The earth's atmosphere is being changed at an unprecedented rate by pollutants resulting from human activities, inefficient and wasteful fossil fuel use and the effects of rapid population growth... These changes represent a major threat to international security and are already having harmful consequences over many parts of the globe.

"The best predictions (of global consequences) indicate potentially severe economic and social dislocation for present and future generations, which will worsen international tensions and increase risk of conflicts between and within nations. It is imperative to act now."

We have discussed many serious concerns in the past decade of *Environment Views*. Acid rain, loss of agricultural land and the contamination of groundwater are all issues requiring urgent action, but these pale in comparison to the havoc predicted as a result of disastrously changing atmosphere. Warmer weather will mean more than a longer growing season in cold climates; look for drought periods that are more severe and more frequent than we have experienced so far. Between drought and rising sea levels, huge areas of the world will become uninhabitable, and much of the most productive agricultural land will be eliminated.

At our planning meeting for this issue, several of the members of the editorial board were concerned: should we be presenting such a doom-and-gloom story? Shouldn't we be worrying about scaring people? The concensus from our resource people was that it is entirely appropriate for people to be scared, but that that fear is not necessarily a bad thing. The sooner we all become convinced of the very real dangers posed by the greenhouse effect and other manifestations of manmade climate change, the better.

After all, we are looking for global action and international co-operation on an unprecedented scale. The Call for Action of the delegates tot he Toronto conference is a far-reaching document, calling for changes in energy policies to increase efficiency and reduce emissions; complete elimination of harmful CFC emissions by the end of the century; diligent application of existing technology to control pollution; and drastic reduction in deforestation.

One of the most interesting components of the plan was a call for labelling of products "to allow consumers to judge the nature and extent of the atmospheric contamination that arises from the manufacture and use of the product". Another, related, recommendation was an expansion of environmental education in schools and universities, especially that addressing the issues of global climate change. These two provisions recognize the importance of the individual in making fundamental changes in the way we use the earth's resources.

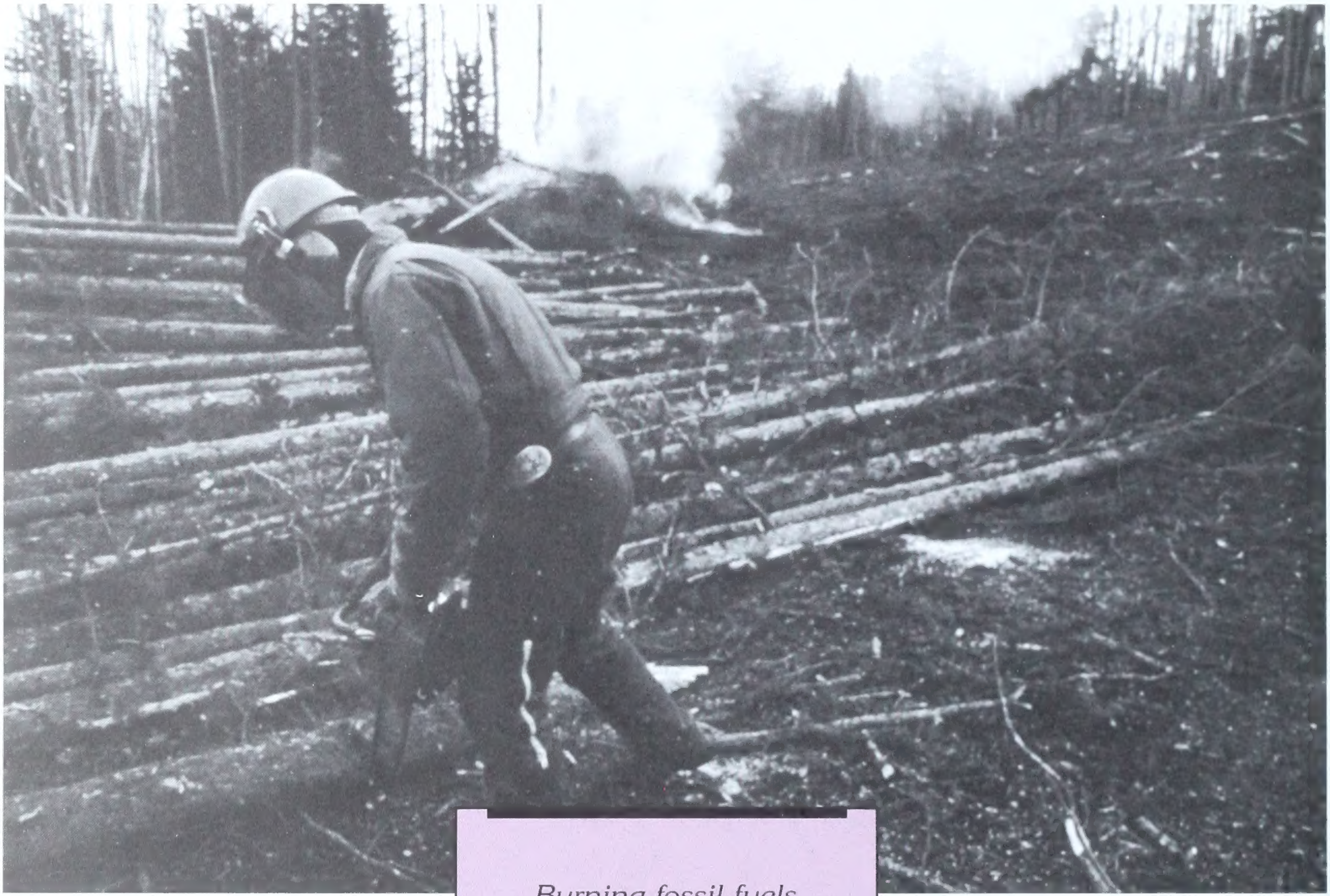
Look to Shirley Serviss' article on page 23 for some suggestions about individual action. But beyond turning down the thermostat and taking the bus to work, concerned people will have to speak out, to convince policy makers that we are willing to spend money and make sacrifices for the sake of the shape of the world we are leaving for our children.

The editor of Environment Views, *Maryhelen Vicars, is a freelance writer and editor based in Edmonton.*

Eric A. Bailey

ATMOSPHERIC PROBLEMS:
A Global Perspective

Human activities turn up the heat



GOVERNMENT OF ALBERTA

Hot smoke pushes up from a new clearing at the edge of the tropical forest. White plumes of steam spread above the canopy — the burning wood is green and wet from a forest freshly cut. For tens of thousands of rural poor in developing nations, these funnels of smoke and steam are banners of liberation, a chance for a better life. The fires also represent another form of liberation — the liberation of carbon into the atmosphere — and this may pose a threat to the survival of our species on earth.

We didn't create the greenhouse effect — it has been part of the basis of life on earth since the atmosphere first formed. Without it, earth would be a frozen lump in space, perhaps 33 degrees colder on average than it is now. The greenhouse effect is natural, but we have turned up the heat.

> *Burning fossil fuels may now be releasing five billion tonnes of carbon in the form of CO_2 every year.*

The burning of fossil fuels may now release close to five billion tonnes of carbon, in the form of carbon dioxide, into the atmosphere every year. The burning of tropical forests may now contribute another two billion tonnes a year, a problem slightly compounded by the fact that there are fewer trees to remove carbon from the air by photosynthesis.

Not only do we pump more "greenhouse" gas into the atmosphere every year, but the rate we pump it is increasing by about 2.2 per cent per year. Levels of carbon dioxide in the atmosphere are expected to increase a further 30 per cent in the next 50 years.

According to the United Nations Environment Program (UNEP), a likely outcome of world warming in northern latitudes would be shorter and wetter winters, and longer and drier summers. Subtropical regions might become even drier than they are now and tropical ones even wetter.

As the oceans warm up and expand, sea levels will rise, leading to severe flooding over low-level land. In tropical areas where rainfall may increase, unstable soils in newly deforested areas will erode at a greater pace. In subtropical areas where rainfall may decrease and stands of open forest are already diminishing quickly, the process of desertification will also accelerate.

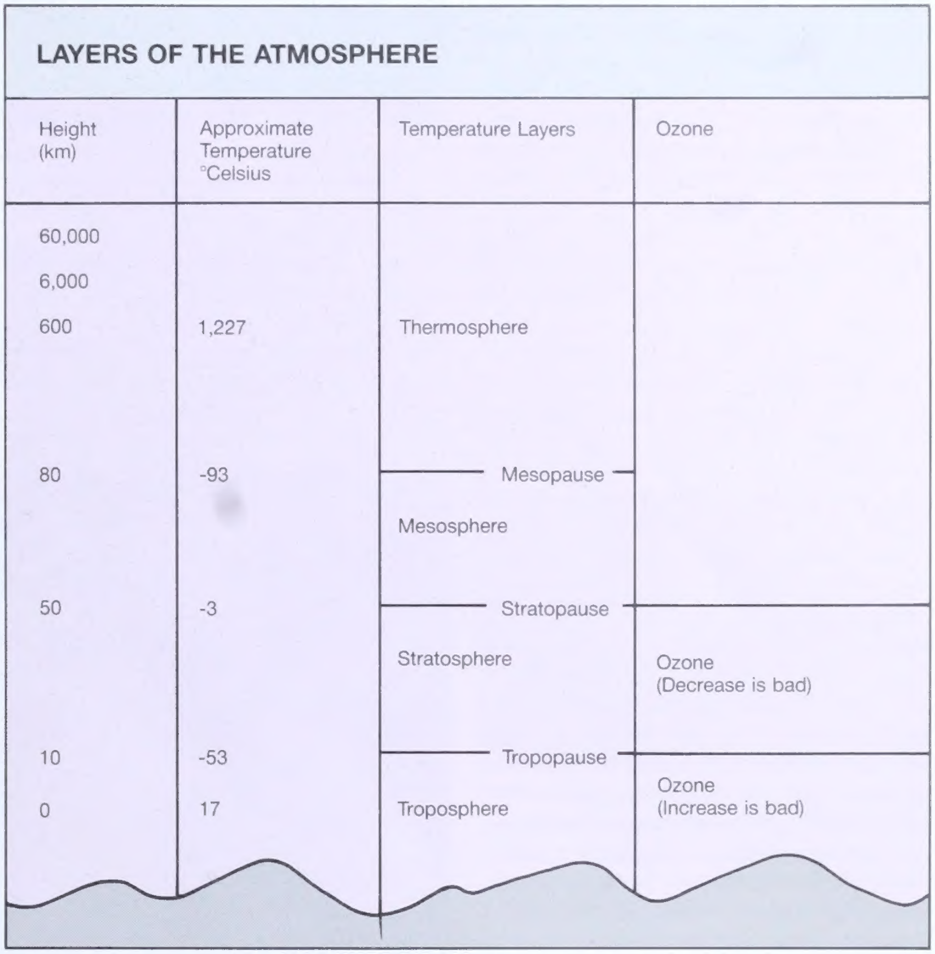
Many other gases contribute to the greenhouse effect — nitrous oxide, methane, ozone and chlorofluorocarbons (CFCs), chiefly. Some of these gases are persistent in the atmosphere; CFCs, for example, will last many decades. Scientists now predict that these other greenhouse gases may have as much impact on global climate change by the end of the century as carbon dioxide.

Ozone holds a special place in the greenhouse formula. While it acts as a greenhouse gas in the lower atmosphere, in the upper atmosphere it acts as a filter for ultraviolet radiation. Sunburn, snow blindness, eye damage, skin cancer, and the aging and wrinkling of skin are caused by ultraviolet radiation which may also interfere with our bodies' immune systems, making people more susceptible to such infectious diseases as herpes and leprosy. Ultraviolet radiation also slows photosynthesis and delays germination in many plants, including trees and crops. Other trace greenhouse gases, the CFCs, act as catalysts in the natural breakdown of ozone. As more CFCs find their way into the upper atmosphere, the ozone there will break down even faster as ozone as a byproduct of human activities builds up in the lower atmosphere, contributing to greenhouse warming.

Taken as a whole, the upper atmosphere has not shown significant decreases in the concentration of ozone. However, scientists are concerned about a seasonal thinning of the ozone layer over the Antarctic in recent years and a similar thinning that has recently been measured over the Arctic. Again, UNEP predicts dire consequences: "If chemicals continue to be produced at current rates, ozone levels in the upper atmosphere will fall by a few per cent during the first half of the next century. This could lead to increased skin cancer and eye disease, smaller crop and timber yields and damage to ocean ecology."

At the world conference on *The Changing Atmosphere: Implications for Global Security*, held this June in Toronto, the topic that riveted the 360 scientists and government officials from 46 countries was the greenhouse effect and dramatic pronouncements from such respected climatologists as Kenneth Hare, chancellor of Trent University in Peterborough, Ontario who declared: "The greenhouse effect has shown itself . . . We are indeed witnessing the beginning of the process." He said "the eclipse of the species" could be man's penalty for failing to take action on the greenhouse effect.

The Toronto conference produced a final statement that called for quick action on many fronts related to atmospheric quality. Programs and policies directed at reducing CFC and carbon dioxide emissions were first on the list. The document stated that carbon dioxide emission levels would have to be cut in half in order to stabilize concentrations of the gas in the atmosphere. In particular, a 20 per cent reduction by the year 2005 was targeted as a starting point. Energy efficiency, alternate sources of energy, improvements in energy supply and recommendations about topics requiring more study were also addressed in the statement.



LAYERS OF THE ATMOSPHERE

Height (km)	Approximate Temperature °Celsius	Temperature Layers	Ozone
60,000			
6,000			
600	1,227	Thermosphere	
80	-93	Mesopause	
		Mesosphere	
50	-3	Stratopause	
		Stratosphere	Ozone (Decrease is bad)
10	-53	Tropopause	
			Ozone (Increase is bad)
0	17	Troposphere	

Conference delegates made the following specific recommendations for reducing carbon dioxide emissions:

- switching to lower carbon-dioxide-emitting fuels;
- reviewing strategies for the implementation of renewable energy, especially advanced biomass conversion technology; and
- revisiting the nuclear power option that lost credibility because of problems related to nuclear safety, radioactive wastes and nuclear weapons proliferation.

They further stated that "through improved engineering designs and institutional arrangements, nuclear power could have a role to play in lowering carbon dioxide emissions."

Addressing the needs of developing nations while attempting to curb carbon dioxide emissions presents an especially painful dilemma — currently, the path to economic and social development is usually seen as an emulation of the steps developed nations have taken to arrive at their high standards of living, including uncontrolled exploitation of natural resources and the use of fossil fuels for energy. Deforestation in developing nations has resulted from the uncontrolled exploitation of resources even though this practice leads to the loss of economically viable industries. UNEP predicts that of the 33 developing countries that are now net exporters of forest products, only 10 will continue to be by the year 2000.

The trend in agriculture in developing nations is toward greater mechanization and more chemical fertilizers, both of which consume fossil fuels and release greenhouse gases. The World Bank reports the average energy consumption per capita of developing economies expressed in kilograms of oil equivalent was 506 in 1986 while the average for industrial market economies was 4,952 and Canada, which leads the world in this measurement, was 8,945. The link between commercial energy consumption and traditional economic development is strong. The generation of energy depends heavily on the burning of fossil fuels, particularly where hydroelectric power potential is not great. The fact that most developing nations are net importers of energy only serves to widen the gap between the developed and the developing world.

"Standards of living are so abysmal that improvements have to occur and it's hard to imagine that fossil fuel use in the Third World isn't going to increase," says Terry Veeman, professor of economics and agricultural economics at the University of Alberta.

In the face of a lesson in economic development which says, in effect, that in order to develop, a nation must contribute more significantly to the greenhouse effect, efforts to reduce carbon dioxide emissions must display a special sensitivity to the needs of less developed nations. *The Changing Atmosphere* conference acknowledged some of these needs in its final statement. It recommended special forms of participation for developing nations in projects to reduce emissions through alternate technology.

"We have to try to get low-cost alternate energy sources into the hands of Third World countries. This could involve some fossil fuel use but they should move more toward hydro and solar sources of energy," Veeman says. "There will also be a greater onus on the developed world to reduce fossil fuel use, as fossil fuel use in less developed countries increases."

Developed nations do not always consider the needs of others. Action on solutions to environmental problems often depends on a simple cost-benefit analysis.

Nigel Bankes, associate professor of law at the University of Calgary, who has served as an environmental law consultant for the Department of External Affairs, says a state often "looks at the results it wants to achieve and what the cost of the most efficacious result will be.

"It is possible, for example, for a state like the United States to take preventive or ameliorative measures with regard to a warming climate. It can afford to continue polluting and to build dikes to protect coastal areas from flooding. Unfortunately, a state like Bangladesh can't," Bankes says.

GOVERNMENT OF ALBERTA

Dr. Terry Veeman

He cites current international environmental protection negotiations as examples of how cost-benefit analysis can speed up or stall proceedings. "The U.S. exerted a lot of pressure to resolve the ozone problem," he said, drawing a simple contrast between the massive cost of health care and the relatively low cost of replacing CFCs with more benign chemicals. On the other hand, negotiations over a solution to the acid rain problem have moved at a snail's pace. "The U.S. benefits from acid rain, it loses on ozone," Bankes says.

The number of nations party to an agreement can complicate negotiations and enforcement. The U.S. and Canada are

TRAVEL ALBERTA

The life of temperate zone glaciers like the Angel Glacier on Mount Edith Cavell is threatened by global warming. Automobile exhaust (right) is a significant source of air pollution.

Toward a Global Law of the Atmosphere

Right now, air pollution is the only industrial commodity freely traded among all nations of the world. At a meeting in Ottawa, February 20 to 22, 80 legal and environmental policy experts from 35 nations will begin work on a global agreement to end this toxic form of free trade.

At last June's *The Changing Atmosphere* conference in Toronto, Prime Minister Brian Mulroney challenged participants to develop a global law of the atmosphere to present to the United Nations Conference on Sustainable Development scheduled for sometime in 1992.

Canada's own departments of Environment and External Affairs have taken up the challenge, organizing the framework meeting in Ottawa next February. According to Doug Russell, a senior policy advisor in the Atmospheric Environment Service of Environment Canada in Ottawa, there are two parts to international laws governing the environment: a foundation framework and a set of protocols.

''In the framework, nations agree on the basic problem,'' Russell says. ''The protocols add real teeth to the agreement later, concentrating on specific chemicals and timetables for correction.''

The framework meeting in Ottawa will work in four particular areas: co-operation between states and concrete ways to promote it; obligations of states and countries; how to settle disputes; and what the structure of the framework should be. In addition, the meeting will produce a plan for the steps that should be taken to achieve the 1992 completion deadline.

''That's a very ambitious schedule for an international law,'' says Russell. ''There are a lot of differing opinions world-wide about what should be addressed first in global atmosphere pollution and how to go about addressing them. These need to be thoroughly hashed out and everyone has to have a say. But everybody would like to see this thing advance as quickly as possible.''

Russell sees Canada's role in the process as one of an honest broker other nations have come to trust in environmental matters.

Drafting the framework will be challenging but negotiating each of the protocols to follow will be the true test of international will to clean up the atmosphere. Those protocols will call for limits on emissions of greenhouse gases, among others, which will certainly represent reductions on the part of developed nations. Those limits may also pose new obstacles to economic growth in developing nations and force all of us to adapt to ways of living that produce less greenhouse gas.

The protocols may be hard to negotiate and hard to live with. Still, such limits will be easier to accept than the inevitable alternative.

GOVERNMENT OF ALBERTA

party to several bilateral agreements on environmental issues such as those negotiated to protect the Great Lakes. Canada is also party to many regional agreements, one of the most recent being the Nitrogen Oxides (NOX) Protocol signed November 1 by members of the United Nations' Economic Commission for Europe. Signatories agreed to reduce NOX emissions on a specific timetable. Global agreements on the environment may be the most difficult to negotiate, simply because of a potentially greater variation in the interests of the parties. In June, Canada ratified the Montreal Protocol for the Protection of the Ozone Layer which is expected to come into effect January 1, 1989. This pact establishes a timetable to control major industrial substances which deplete the ozone layer. However, before it can take effect, the protocol must be ratified by at least 11 countries accounting for at least two-thirds of the global 1986 consumption of ozone-depleting chemicals (CFCs and halons).

> *...efforts to reduce carbon dioxide emissions must display a special sensitivity to the needs of less developed nations.*

These are all examples of agreements among developed nations. The Toronto conference called for a ''global convention as a framework for protocols on the protection of the atmosphere,'' which it recommended should be ''vigorously pursued'' at a conference to be held in Ottawa in February 1989. Already, the gathering is being called a ''Law of the Atmosphere'' conference and high hopes have been pinned on the outcome. If it can address issues of atmospheric change within the context of the disparity between developing and developed nations, it will be breaking new ground in international agreements.

If not, we will have to learn to live with the new planet we create. ''Man will adapt — we won't just run into the sea like lemmings,'' Dr. Veeman says.

Eric Bailey is a freelance writer specializing in outdoor and interpretive writing, working from Alder Flats.

Conrad Gietz

THE SCIENCE OF

The Changing Atmosphere

Questions, answers and definitions

Q: What is the greenhouse effect?

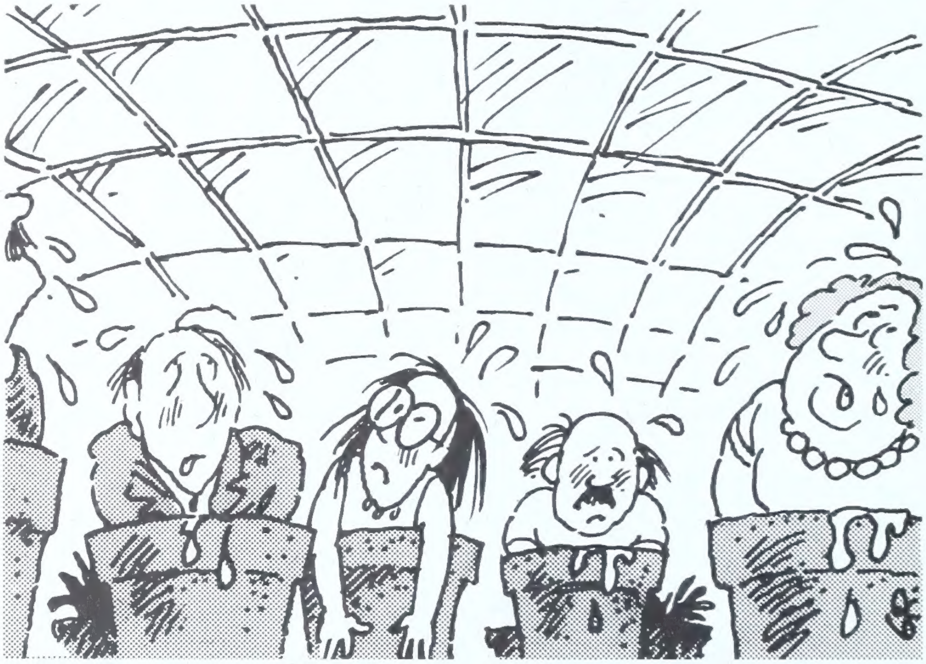
A: Radical temperature shifts of either the earth's surface or the atmosphere are prevented when incoming radiation from the sun is balanced by invisible infrared radiation escaping out to space. As part of the balance, some of the escaping radiation is intercepted by so-called *greenhouse* gases before it can leave the atmosphere. This has the effect of retaining heat in the atmosphere, and has become known as the *greenhouse effect*.

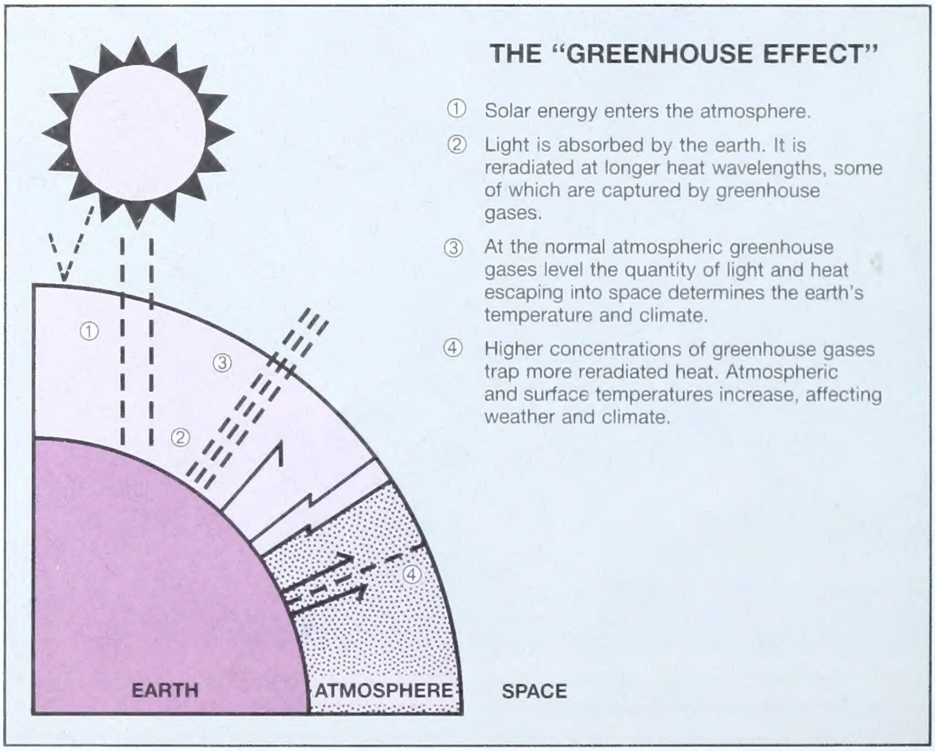
The term "greenhouse effect" dates back to the 1930s, but the phenomenon has become the focus of growing concern in recent years because measurements show that quantities of greenhouse gases, especially carbon dioxide, in the atmosphere have been increasing. This is shifting the earth's energy balance, and threatens to raise global temperatures at a rate never experienced in human history.

Q: What are the greenhouse gases? Where do they come from?

A: The best-known of the greenhouse gases is carbon dioxide (CO_2), probably because it is the most plentiful, and is responsible for at least half of the greenhouse effect. But there are up to 20 other greenhouse gases in the atmosphere. The most important of these are the chlorofluorocarbons (CFCs), ozone, methane and nitrous oxide.

Concentrations of *carbon dioxide* have increased from pre-industrial levels by about 25 per cent in 200 years. This increase has been caused largely by the rapid growth in the use of fossil fuels, which has accompanied the advance of industrialization. It has been estimated that the burning of oil, gas and coal is releasing carbon into the atmosphere as gaseous carbon dioxide at about five billion tonnes per year. That's equivalent to 10,000 tonnes per minute, nonstop. Another major source of atmospheric carbon dioxide is the burning of large tracts of





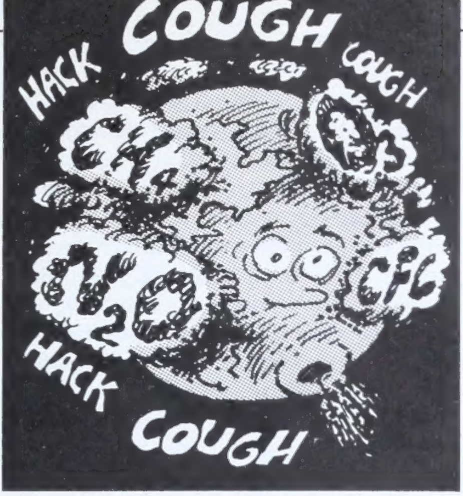
THE "GREENHOUSE EFFECT"

① Solar energy enters the atmosphere.

② Light is absorbed by the earth. It is reradiated at longer heat wavelengths, some of which are captured by greenhouse gases.

③ At the normal atmospheric greenhouse gases level the quantity of light and heat escaping into space determines the earth's temperature and climate.

④ Higher concentrations of greenhouse gases trap more reradiated heat. Atmospheric and surface temperatures increase, affecting weather and climate.



forest to clear land for development, mainly in the tropics. A huge quantity of carbon previously stored in natural vegetation is suddenly released into the atmosphere. This slash-and-burn deforestation accounts for the release of one to two billion tonnes of carbon as carbon dioxide annually.

Natural ecosystems, the oceans in particular, are able to remove about half of the excess carbon dioxide put into the atmosphere by human activities. The remaining half is responsible for the increase in global concentrations of this greenhouse gas.

A group of industrially produced gases known as CFCs or freon gases, contributes strongly to the greenhouse effect. While CFCs are far less abundant than carbon dioxide, they have about 10,000 times the impact on climate, molecule for molecule, and are responsible for one quarter of the greenhouse effect. CFCs are of special concern, because once formed, they resist chemical breakdown in the lower atmosphere and may persist for more than a century.

When concerns about ozone depletion were first publicized, aerosol spray cans were a major source of CFCs. A combination of government regulation and consumer education has already curbed this source of emissions. However, in the 1980s, world production of CFCs began to increase once again. They are used extensively to produce foam products for packaging and insulation. CFCs have also been introduced as solvents for cleaning microchips and other electronic components. This is in addition to the longstanding use of CFCs in refrigeration and air conditioning.

Ozone (O_3) is best known as the gas that shields the earth from harmful ultraviolet radiation, but it is also an important air pollutant and a greenhouse gas. About 90 per cent of the world's ozone occurs naturally in a stratospheric layer some 15 to 35 kilometres above the earth's surface. However, concentrations of ozone in the lower atmosphere have been increasing as a result of urban and industrial pollution. Unlike the freon gases, ozone is unstable and subject to chemical breakdown.

The earth's high-altitude ozone shield shouldn't be confused with near-surface buildups of ozone pollution that sometimes pose a serious health hazard in urban areas for days or weeks at a time.

Methane (CH_4) is a greenhouse gas produced naturally by the breakdown of vegetation in processes where the supply of oxygen is limited — rotting, digestion and burning. Human activities have accelerated the rate of methane release. It is estimated that nearly half of the global release of methane is associated with cattle populations and rotting vegetation in rice paddies. Burning wood produces lesser amounts of methane, perhaps 20 per cent of the total. Most of the remainder is released by coal mining or the extraction of other fossil fuels and by natural sources such as swamps and marshes.

Nitrous oxide (N_2O) occurs naturally, produced by lightning and the biosphere. But as with most other greenhouse gases, concentrations of nitrous oxide have been boosted by human activities, in particular, by the use of nitrogen-containing chemical fertilizers and the combustion of fossil fuels. About one third of the atmospheric nitrous oxide is thought to be of human origin.

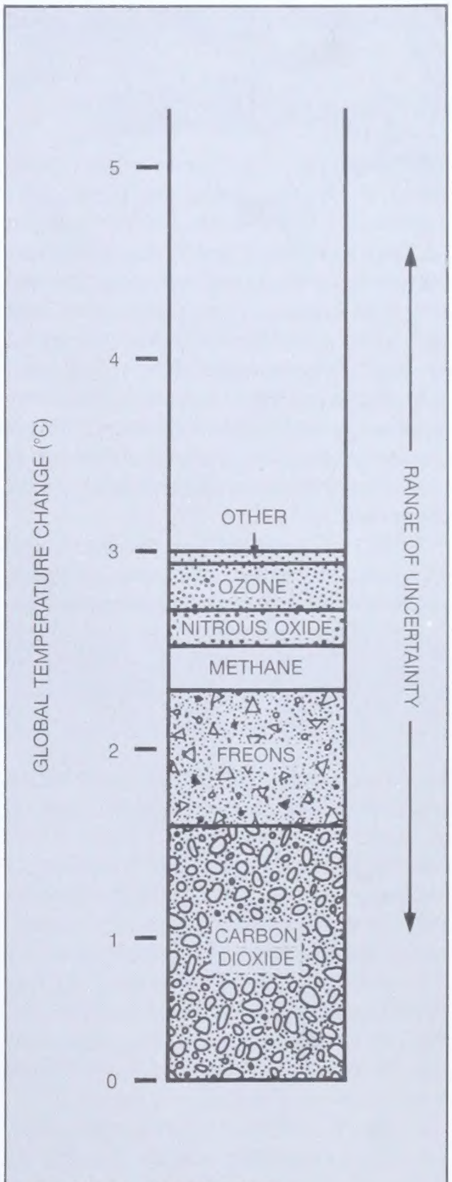
Q: What will be the impact of the greenhouse effect?

A: Global average temperature and the severity and frequency of extreme weather events are expected to increase, and this is likely to result in major economic and social impacts around the world within the next century. Many scientists believe that the greenhouse effect is already being felt. The rate of warming predicted depends on projections of emissions of greenhouse gases, and on the sensitivity of the earth's energy balance to changes in the composition of the atmosphere. Based on existing emission trends, recent projections show an increase in globally and annually averaged temperature of about 1.5°C by the year 2050 and more than 3°C by 2100. There are uncertainties of a degree or more either way associated with these projections, which are based on highly complex yet incomplete scientific models of the earth-atmosphere system.

A temperature increase of a few degrees may seem modest unless one realizes that the anticipated temperature shift is unprecedented in human history. Warmer temperatures would have a number of direct effects: sea levels could be a metre higher by the year 2050, and frost-free seasons could be extended by a month or two at high latitudes. In addition, there would be important impacts on the global moisture regime. Although these effects are very difficult to predict, most climate prediction models indicate increased probabilities of prairie drought, owing largely to increased potential evaporation. Temperature increases are expected to be greatest at high latitudes, and more pronounced in winter than in summer.

Q: Can the greenhouse effect be reversed?

A: Even if emissions of carbon dioxide were stopped today, it would take hundreds



GLOBAL WARMING

Global temperature may rise an average of 3°C by the year 2030. The major contributors to this warming are expected to be carbon dioxide and CFCs, with the other greenhouse gases having lesser effects, as indicated (based on current rates of emission).

of years for the atmospheric concentration of carbon dioxide to return to its pre-industrial level. In the meantime, climatic warming would continue. And even if the release of CFCs, the second most important contributors to the greenhouse effect, could be halted immediately, most of the CFCs ever produced would still be in the atmosphere for decades to come. Nevertheless, studies indicate that reductions in the emissions of greenhouse gases would at least reduce the rate of atmospheric warming, and possibly stabilize temperatures at some future time. It is particularly urgent to reduce emissions of CFCs because of their effect on the stratospheric ozone layer.

Q: What is the ozone layer?

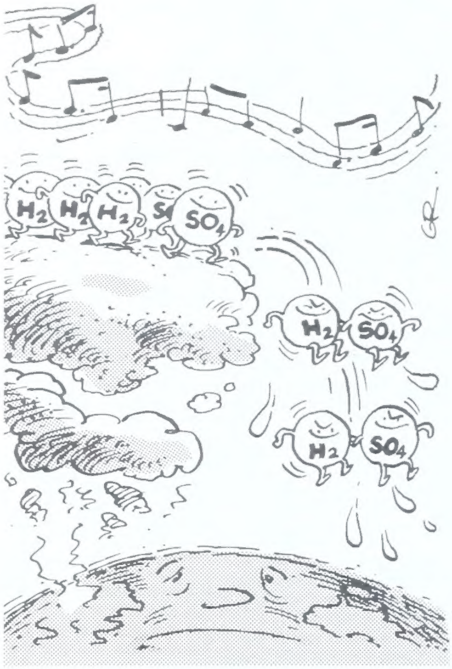
A: Sometimes referred to as the ozone shield, the stratospheric ozone layer is best known for the vital protection it provides to the earth by selectively filtering out potentially harmful ultraviolet radiation from the sun. The ozone is highly dispersed in a layer of between 15 and 35 kilometres above the earth. If compressed to sea-level pressure, the ozone shield would form a layer less than a centimetre thick. Ozone (O_3) is a close relative of oxygen gas (O_2), but is much less stable and vulnerable to chemical breakdown.

Without the naturally occurring ozone, ultraviolet radiation would cause very serious problems. Excessive exposure to ultraviolet radiation interferes with normal cell reproduction in humans, animals and plants, and is destructive to many plastics, paints and other materials.

Q: What's causing depletion of the ozone layer, and what can be done about it?

A: Scientists have identified a number of pollutant gases whose chemical offshoots are capable of destroying ozone on contact. CFCs and bromine-containing gases are the most important known agents of this kind. Methane and nitrous oxide have similar effects. Ozone can also be destroyed directly by carbon monoxide and carbon dioxide.

It wasn't until the 1970s that researchers began focusing public attention on threats to the natural ozone layer, predicting that certain pollutants would eventually find their way into the upper atmosphere and trigger the chemical breakdown of ozone. This seems to have been confirmed by measurements revealing that the ozone shield has been thinning out. The so-called Antarctic ozone hole was detected — a seasonal thinning of the ozone layer that has been expanding. More recently, a less-pronounced thinning of the ozone layer has been noted over the Arctic north of Norway. It's still uncertain whether this thinning is temporary or whether it is likely to expand further. Meanwhile, roughly 800,000 to one million tonnes of CFCs are being added to the atmosphere each year.



Initiatives to protect the ozone layer have centred mainly on controlling CFC emissions. Not only are these gases extremely powerful agents of ozone depletion, they are capable of lasting a century or more in the atmosphere. This means that the existing buildup of CFCs will continue to attack the ozone layer for the next century at least, but perhaps at gradually declining rates if emissions of CFCs and other ozone-destroying gases can be radically curtailed in the near future.

A precedent-setting international agreement to protect the ozone layer was signed in Montreal last September. This agreement, known as the Montreal Protocol, regulates the production of substances that deplete the ozone layer, including CFCs. It is expected that the protocol will take effect in January 1989. The agreement sets out a schedule for decreasing the production of CFCs in stages.

Q: What is acid rain or acidic deposition?

A: When pollutants such as sulphur dioxide (SO_2) and oxides of nitrogen are put into the atmosphere, they often undergo chemical transformations. Sulphur dioxide, the most important contributor to acid rain, is gradually converted to sulphuric acid (H_2SO_4) which condenses to form droplets. These acid droplets readily dissolve in rain or cloud droplets, and fall to earth as precipitation, often hundreds of kilometres from the pollution source.

Acid rain harms trees and other plant life, and causes deterioration of structures containing calcareous materials such as limestone. Over a period of years, acid deposition occurs and it acidifies water and susceptible soils. This in turn can seriously harm fish populations and vegetation, and has already caused widespread damage in Europe and North America. Acidification of water supplies also raises the spectre of increased mobility of heavy metals into supplies of drinking water, and dangerously high levels of heavy metals in fish.

It is no accident that the harmful effects of acid deposition are most noticeable in eastern North America and in central and northern Europe. These densely populated and heavily industrialized regions have been injecting huge quantities of sulphur into the air through millions of chimneys and smokestacks for scores or even hundreds of years. In Canada, the effects of acid rain are most visible in Ontario and Quebec, where numerous lakes no longer support aquatic life. Susceptible soils have become increasingly acidified, and trees and other types of vegetation are weakened or dying in the most hard-hit regions.

Q: What can be done about the acid rain problem?

A: Most of the sulphur dioxide and nitrous oxides (acid gases) added to the atmosphere are deposited on land and water bodies within days or weeks. It follows that reductions in acid gas emissions would quickly reduce atmospheric concentrations of this gas. Much more time would be required for the damaged components of the ecosystem to recover, however — to ameliorate an acidified soil and then to re-establish a forest, for example.

The technology to greatly reduce sulphur dioxide emissions is available today. Smokestacks can be fitted with scrubbers to remove sulphur. Energy conservation measures and the use of cleaner energy sources are additional options that would reduce the amount of sulphur dioxide in the air. But political commitment is needed to bring about improvement. Decision makers must sometimes choose between short-term costs to reduce pollution, and the untold cost of damaging the natural environment, perhaps beyond repair.

Q: What is arctic haze?

A: Even in the remote Arctic, it has become common to observe a widespread brownish yellow haze during the winter. This so-called arctic haze is made up of sulphur compounds and other gases, as well as soot particles. Scientists have identified the sources of this pollution as industrial areas of the USSR, Europe and North America. Arctic haze dissipates in the spring, when the pool of cold air over polar regions begins to break up. It can reduce visibility in low-level flight and is a worrisome reminder of the significance of the long-range transport of air pollutants in global air pollution.

Q: Are there other serious atmospheric pollution problems?

A: There are several. Urban areas experience dangerous and unpleasant buildups of *smog*, made up from the mix of chemical pollutants and particulates released into the air in large quantities wherever human populations and industrial activities are concentrated. The most severe smog conditions occur when a stagnant weather pattern settles in over a populous area for days or weeks at a time, and a temperature inversion aloft prevents polluted surface air from mixing vertically with cleaner air above. In Canada, these conditions are usually associated with slowly moving high pressure areas and relatively extreme hot summer or cold winter temperatures.

Ozone is a particularly bothersome and harmful ingredient of urban smog, irritating the eyes, causing respiratory problems and damaging vegetation. The term *photochemical smog* has come into use because ozone in smog is formed as a result of the chemical breakup and recombination of other pollutants, stimulated by energy from the sun's rays. It is estimated that roughly 75 per cent of ozone-forming pollutants come from automobile exhaust. Coal-burning plants are responsible for much of the remainder.

Airborne *toxic chemicals* like dioxins and heavy metals can be transported hundreds of kilometres, adding to the pollution load that threatens health and the environment. Dioxins are produced by a variety of combustion sources, including incinerators and automobiles. Emissions can often be curtailed or eliminated by efficient incineration and the use of catalytic converters. Toxic metals such as mercury, cadmium and lead are also being transported and deposited by the atmosphere.

Conrad Gietz is a freelance writer and editor specializing in technical subject matter.

ADRP Report Acid Rain Update

Alberta does not have a problem with acid rain, nor is it likely to, according to the report, *Present and Potential Effects of Acid and Acidifying Air Pollutants on Alberta's Environment*.

The paper, published this fall by the Acid Deposition Research Program (ARDP) is the culmination of three and one-half years of intensive study by 30 researchers in 20 different disciplines.

The $11 million biophysics research program was designed to determine present and future risks of environmental impacts from the emission of nitrogen and sulphur pollutants within the province.

As part of the project, a world literature review of all aspects of the problem of acidic deposition and its impacts was prepared. Three field stations were established to measure regional air quality and determine how this air quality is modified by emissions. The resulting data were integrated with computer modelling to predict the possible effects of exposure to various air pollutants on crops, soils and the province's lakes and rivers.

The study's results suggest that the atmospheric deposition of acidifying substances isn't demonstrably hurting the Alberta environment. In many areas of the province, the slightly alkaline nature of the soil and water has the capacity to neutralize acid deposition. Even extreme future increases in acid deposition would result in airborne concentrations too low to affect wheat.

However, exceptions exist. For some restricted areas of the province — with more acidic soils and water — additional acid gas emissions could create a problem. Small impacts on alfalfa growth were also found in a few areas. Further studies of the possible impact of combined sulphur dioxide and ozone on alfalfa yields were recommended.

The literature reviews conducted in conjunction with this project and the data generated through the air quality monitoring program constitute a major resource of information. It is also recommended that steps should be taken to provide periodic updating of the emission inventory and the world literature reviews.

The Acid Deposition Research Program is funded and administered by the province of Alberta, the Canadian Petroleum Association, Alberta's electrical utilities and the Energy Resources Conservation Board.

The Canadian Petroleum Association devoted much of its October issue of the CPA Review to an analysis of the ARDP report. A copy of the CPA Review is available by contacting the editor, Peter McKenzie-Brown at (403) 269-6721 or Fax: (403) 261-4622 or by writing to him at The Canadian Petroleum Association, 3800, 150 Sixth Avenue, S.W., Calgary, Alberta T2P 3Y7.

— Shirley Serviss

Conrad Gietz

LOOKING FORWARD
To a Warmer Alberta

What's in store for us?

TRAVEL ALBERTA

Imagine, if you will: It's the year 2050, a perfect summer day in Banff National Park. Admiring the view from the front of the old Chateau Lake Louise, you can't help overhearing a group of tourists marvel out loud how different things look now.

"That bowl-shaped area at the end of the lake used to be full of ice," you hear one of them say. "And over there," someone says, pointing up to the left, "that used to be a major ski hill."

Later, on your way out of the park, you stop for a while at a viewpoint from which you used to be able to see the toe of the Athabasca Glacier. It hasn't been visible from there for years now. Reflecting on the day's impressions, you understand something about why these and so many other changes have taken place, but you still wonder where it's all leading to.

Increasing temperatures will accelerate the retreat of the glaciers and snowfields of the Rockies.

But wait just a minute. Is this really the kind of thing we should expect from the greenhouse effect? How much temperature increase is likely, and how will it affect Alberta? These are hard questions and the answers are not easy to come by. Still, these kinds of questions are being asked more and more frequently as our knowledge of the greenhouse effect builds, and seems to point with increasing certainty to a future with higher temperatures.

The latest available scientific projections of temperature suggest that by the year 2050, an increase in globally and annually averaged temperature of about 1.5 degrees (Celsius) is entirely possible, based on existing trends in the emission of greenhouse gases. There are regional implications too, although these are more speculative. Most projections of the greenhouse effect indicate that the temperature increase is likely to be greatest at high latitudes, and more pronounced in winter than in summer.

Considering all of this, it may not be unreasonable to foresee an Alberta that is from two to 3.5 degrees warmer in the north, depending on the season, and from 1.5 to two degrees warmer in central and southern areas. While there is considerable uncertainty connected with these projections, a degree or more either way, this scenario comes close to the consensus of scientific opinion.

What then can we expect if this *is* the situation by the year 2050? How will the change affect agriculture, our forests, wildlife and the many other special things about Alberta that are sensitive to climate, not the least of which is the view in Banff National Park?

Even with a longer growing season, agriculture productivity would continue to be limited by the supply of soil moisture, creating more demand for irrigation water projects.

The scenario described at the beginning of this article is really already in preparation because we are living in a post-glacial era. Bruce Rains, associate professor of geography at the University of Alberta, and an expert on glaciers, points out that the retreat of most temperate-zone glaciers has been a "worldwide phenomenon" for two or three centuries. "And if you start increasing mean annual temperatures," he says, "you're just going to accelerate what's been going on." He notes that as recently as around 1800, the Athabasca Glacier was about 1.5 kilometres longer, extending to just down-valley from the Icefield Parkway.

Dr. Rains says that, given a warming trend, the melting or "wasting" of ice will always occur most rapidly in ice formations where the ice temperatures are near the melting point. This is the case with temperate-zone glaciers like the Bow and the Athabasca, and even more so with smaller cirque-type ice formations like the picturesque one at the south end of Lake Louise.

Dr. Rains predicts a temperature increase of several degrees would eventually have very drastic consequences for temperate-zone glaciers and snowfields. In centuries past, temperature differences of only about three degrees have distinguished periods of glaciation from interglacial periods.

Snow cover is also relatively sensitive to shifts in temperature. In our scenario, snow cover would be far less extensive, and sporadic on ski slopes in subalpine and even some mountain locations.

The growing season for agricultural crops would be from two to five weeks longer in 2050, with a greater range of crops grown, including long-season varieties.

Peter Mills, an agricultural weather specialist at the Agriculture Canada research station near Beaverlodge in northern Alberta, sees potential benefits for northern agriculture: "As you have the ability to plant a longer-season variety," explains Mills, "you also get inherently higher yield."

Farmers in the Peace River region in 2050 could grow highly productive varieties of barley, for example, that have been selected to mature in 105 days, instead of the old 85-day barleys with lower yield potential.

But whether the potential of long-season varieties can be realized depends on adequate supplies of soil moisture. "Drought has traditionally been and is now our number one limiting factor to agriculture in the Peace River region," cautions Peter Mills. "It is not the temperature or the length of the growing season."

And so drought remains the major concern of agriculture in this scenario. However, crops could use the available water more efficiently, a direct benefit from the relatively high concentrations of carbon dioxide in the air. And more and more farmers would plant winter wheat, which in colder times past was grown only in the south. Fall-planted winter wheat gets an early start in spring and thus takes advantage of moisture from snowmelt.

Elsewhere in Alberta too, long-season, high-yield crop varieties are expected to become common, but recurring drought will cause serious hardships.

Peter Dzikowski, climate resources specialist with Alberta Agriculture, emphasizes that the availability of moisture will limit how much farmers can grow. He says that farmers in west-central parts of Alberta may be in the best position to take advantage of the longer growing season, because these areas generally receive more rainfall than other agricultural areas.

Southeastern Alberta, on the other hand, would be particularly dry in our scenario. What little snow cover there was would disappear in March. Soil moisture levels would be minimal and cropping prospects poor. Some of the land that was already marginal for agriculture in the 1980s would be given over to short grass cover. We can expect some of it to be permanently damaged by soil erosion, a problem of special concern in the chinook belt. Conservation tillage methods will be practised widely, to minimize the exposure of bare soil to wind as well as to conserve soil moisture.

In 2050, more than ever before, people will realize that water is a limited resource - something to be conserved. Industry, irrigation agriculture and growing population centres are expected to make use of all available water supplies.

Dr. Teja Singh

According to Ron Deeprose, director of the technical services division of Alberta Environment, water resources are already being strained in southern Alberta by a variety of competing demands. The situation has been compounded by recent drought. Looking ahead, Deeprose expects that it will become increasingly necessary to store temporary excesses of runoff water in reservoirs to ensure adequate water supplies year-round.

Arleigh Laycock, a professor of geography at the University of Alberta, notes that some climatic models indicate possible increases in winter and spring precipitation, particularly over the mountains. This would generate more runoff from mountain-fed streams and increase opportunities for water storage. Dr. Laycock also anticipates "considerably more demand for water, not only in southern Alberta, but in central and northern Alberta, with warmer and drier conditions in the summer and fall."

Teja Singh,a research scientist with the Canadian Forestry Service and his colleagues at the Northern Forest Research Centre have conducted extensive studies into potential impacts of greenhouse warming on forests in Canada. He explains why the most striking changes are expected to occur in "transition zones," like those between boreal forest and aspen parkland, and between aspen parkland and grassland. In these transition zones, the very "sensitive equilibrium" can be upset by even slight shifts in climate. According to Dr. Singh, temperature increases caused by the greenhouse effect could shift the boundaries of the boreal forest "up to 400 kilometres to the north" eventually.

By the year 2050 in our scenario, only part of this shift would be apparent. But there would be signs of environmental stress all around — trees trying to adjust to their changing world. Forest fires are expected to ravage large tracts of the boreal forest. Extensive areas will be planted with species better suited to the warmer climate.

Winter wheat would become a common crop, even in northern Alberta.

GOVERNMENT OF ALBERTA

Forest research will be directed at the development of trees suited to a warming climate.

Dr. Singh points out that broad-scale changes in forest cover don't happen overnight. As he aptly phrases it: "Trees can't just pack up and move" when the going gets tough. Trees planted now have to grow at that site for the next 80 to 100 years before harvest." But climatic pressures are ultimately effective. Stressful conditions are sure to make forests more vulnerable to forest fires, insect infestations and disease, additional stresses that could accelerate the retreat of the boreal forest in Alberta.

Indeed, all types of plant life have been affected by climate changes leading up to our scenario. Meanwhile, wildlife populations too, have been forced to make major adjustments. Waterfowl habitat in southeastern Alberta will have all but disappeared, except for man-made reservoirs. The pintail duck is gone. Flocks of migrating geese will be seen occasionally but they rarely stop over. It will not be hard to find waterfowl species in many parts of Alberta farther north, however.

Look for pronghorn antelope near Edmonton and a population explosion of whitetail deer.

GOVERNMENT OF ALBERTA

Waterfowl breeding and nesting could shift away from southern Alberta as wetlands disappear.

Brent Markham, head of the planning and game management section of Alberta Fish and Wildlife, says that some waterfowl species in Alberta are already under severe environmental stress because of recent drought. The pintail is an example. He predicts that waterfowl breeding and nesting activity in southern Alberta could be shifted to central areas, because of ponds or "sheet water" drying up in the south. However, he is concerned that the duck population in Alberta could decline.

The prospect of a retreat of the boreal forest in Alberta is also of concern to wildlife experts. The range available to forest animals such as moose is likely to be restricted to areas farther north and west in our scenario. Markham notes that part of the pressure is likely to come from the continuing spread of agricultural development in those directions.

But problems are often accompanied by opportunities. Species of birds and other animals better suited to a warmer climate will no doubt move in.

In our scenario, the pronghorn antelope is a case in point. It would become common to see these animals ranging not far from Edmonton.

Brent Markham explains that "winter conditions are the main limiting factor" for this species, which is currently at the northern edge of its range. He adds that they could flourish farther north, given the changes in vegetation likely to accompany climatic warming.

Populations of whitetail deer, widespread in Alberta, have also been regulated largely by winter weather, according to Markham. And he says that climate warming could have important management implications for these "prolific" animals. In the absence of severe winters every few years, whitetail numbers could expand quickly to the point where overpopulation seriously interferes with agriculture.

Conrad Gietz is a freelance writer and editor specializing in technical subject matter.

R. Edrea Daniel

GREENHOUSE WARMING:
Searching for the Facts

What do we really know about our future?

LETHBRIDGE HERALD

An unusual weather pattern called La Niña may be to blame for last year's drought.

During the first five months of 1988, average worldwide temperatures were the highest on record. Parts of Canada and the United States experienced one of the worst droughts in recent memory. The four warmest years of the past century have all been in the 1980s.

James Hansen, atmospheric scientist at NASA's Goddard Institute, caused a sensation this summer with his interpretation of these weather events. Testifying before a U.S. congressional committee, he said his statistics showed with 99 per cent certainty that the high temperatures represent a real warming trend, not a chance event. Dr. Hansen attributes the warming to the greenhouse effect.

"It is clear something unusual is happening," says Henry Hengeveld of Environment Canada. But can we be sure it's the greenhouse effect?

Greenhouse gases allow the sun's rays to pass through the atmosphere, then trap heat energy radiated back from the earth, warming the planet. Without two of these gases, carbon dioxide and water vapor, temperatures on earth would be over 30 degrees colder than they are now. There would be no liquid water, no life as we know it.

With greenhouse gases steadily on the rise, scientists have been looking for a clear signal of greenhouse warming. But it is difficult to detect this kind of signal when we have a climate of such high natural variability. So, in the scientific community, Dr. Hansen's conclusions remain controversial.

Something unusual is happening...but can we be sure it's the greenhouse effect?

One voice of doubt belongs to Michael Schlesinger, an Oregon State University atmospheric scientist. "I feel our confidence is considerably smaller than what Hansen says. Not zero, but much smaller." He notes that different studies of the last century's temperatures "show very good agreement," but adds that the raw temperature data have "confounding" problems and need to be cleaned up before definitive statements can be made.

Looking at temperatures over the past century, Dr. Hansen found an increase of .7 degree. A change of only .2 degree would have been expected with natural variability. There has been more warming at higher latitudes (like Edmonton) than toward the

Tornadoes and other extreme weather phenomena may become more common occurrences.

tropics; greater warming over continents than oceans; and cooling in the higher atmosphere while the lower atmosphere warms up. These trends are all consistent with computer model predictions for greenhouse warming.

Dr. Schlesinger dissents. In his opinion, the way temperatures have increased over the last century is "not what you would predict from greenhouse gases." While concentrations of greenhouse gases have been rising year after year, temperatures have not. Temperatures rose from 1880 to 1940, decreased to 1965, then began to rise again. Schlesinger thinks the 1880 to 1940 increase could be a rebound effect from the Little Ice Age, a period of cold from the sixteenth to nineteenth centuries.

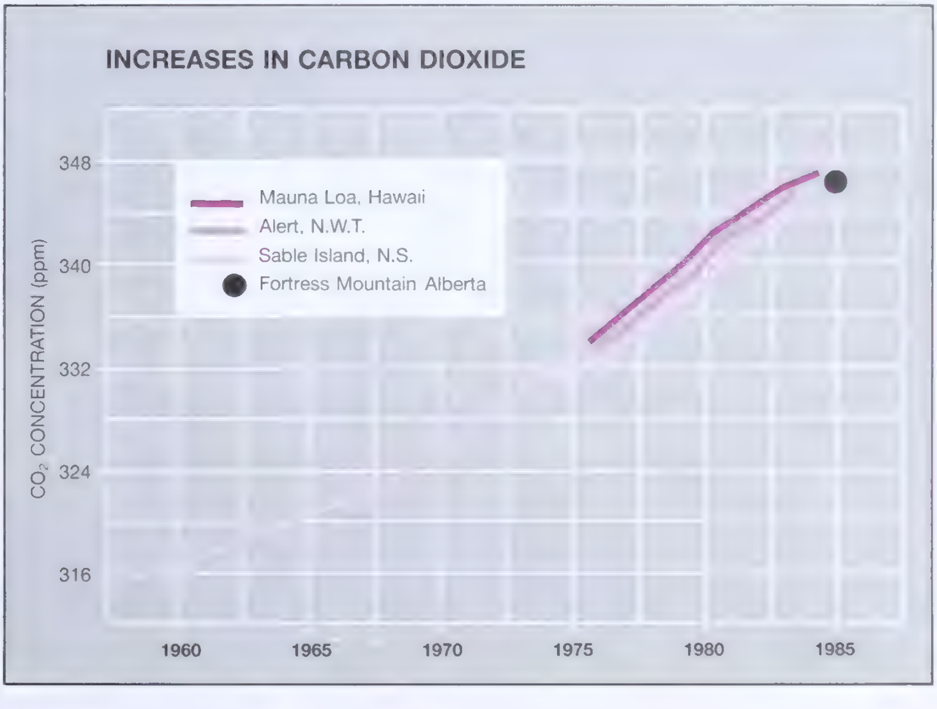
In examining the temperatures of the 1980s, Hansen's group found temperatures rose 0.4 degree, three times as much as would have been expected from natural climate variability. But Dr. Schlesinger thinks this trend could be blamed on El Niño, not greenhouse gases.

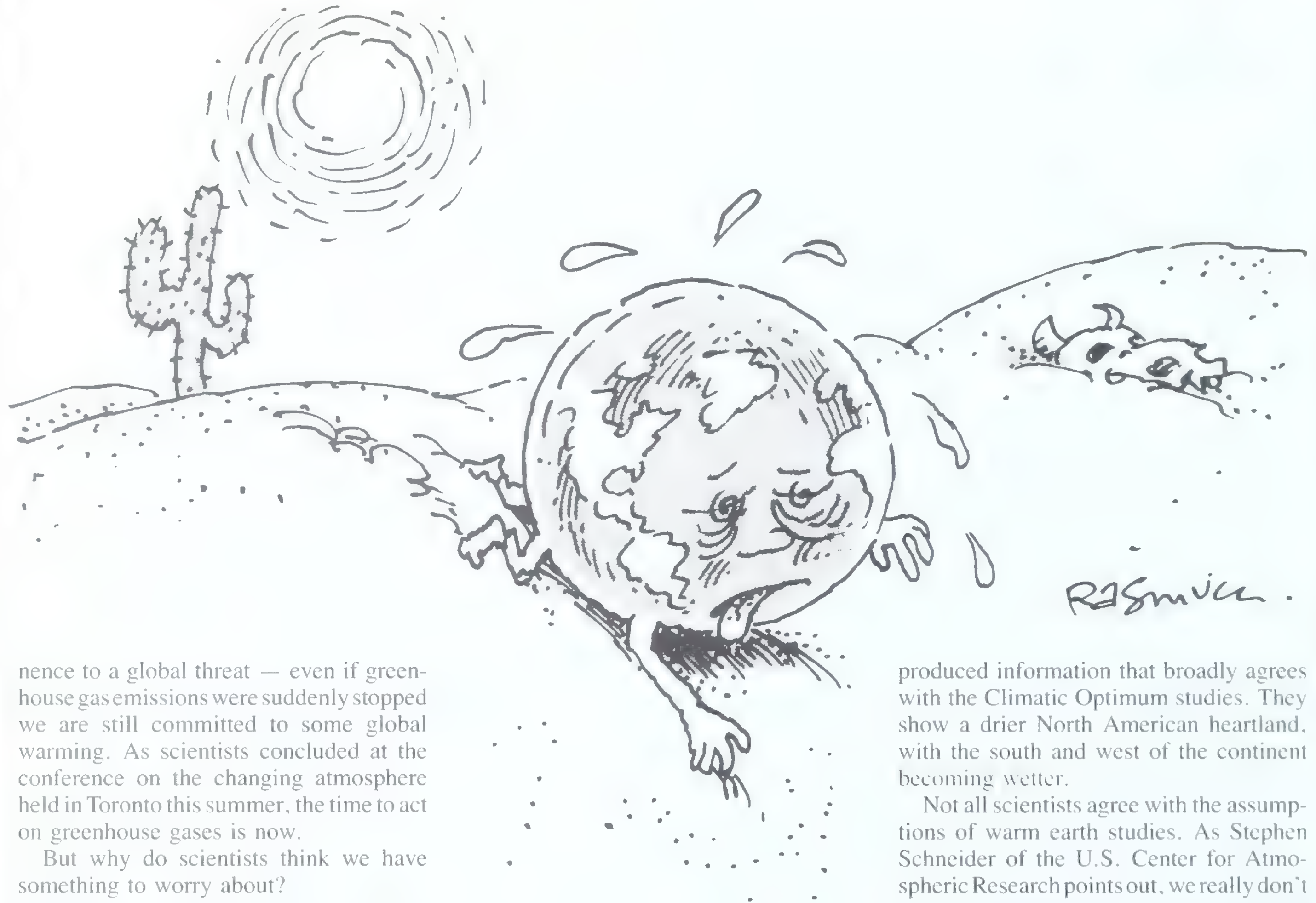
(El Niño is the occasional appearance of warm ocean currents in the tropical eastern Pacific Ocean. This warming affects weather both in the tropics and higher latitudes. Some scientists attribute our recent warm winters to El Niño, but no direct link is yet established.)

There have been two El Niños in the 1980s, coinciding with the decade's warmest years. Also, the 1980s warming trend has occurred mainly in the tropics; to Schlesinger this is more evidence of El Niño at work. He notes that western Europe had no heat wave or drought this summer. It was cold and wet. "One summer drought does not a greenhouse effect make," he adds.

Now some scientists are saying an unusual weather pattern called La Niña may be to blame for this year's drought. La Niña is considered to be a rebound effect of El Niño. It involves a cooling of eastern Pacific waters off South America. Kevin Trenberth, of the U.S. National Center for Atmospheric Research, thinks La Niña pushed storms that normally follow a path over the U.S. Midwest and Canadian prairies northward, drastically reducing rainfall in these areas.

If Michael Schlesinger is correct, then the jury is still out on whether we have had a clear greenhouse signal. But Dr. Hansen lit a media fire. His testimony gave promi-





nence to a global threat — even if greenhouse gas emissions were suddenly stopped we are still committed to some global warming. As scientists concluded at the conference on the changing atmosphere held in Toronto this summer, the time to act on greenhouse gases is now.

But why do scientists think we have something to worry about?

Some of our evidence of the effects of greenhouse gas levels comes from studies of climate in earlier eras. Ice core studies have produced some of our most consistent information on carbon dioxide levels in the planet's past. Ice cores from Antarctica and Greenland show layers of snowfall going back 150,000 years, well before the last interglacial period peaked 125,000 years ago.

Scientists study the concentrations of gases (including carbon dioxide) in "fossilized" air bubbles trapped in the ice.

This carbon dioxide data has been correlated with information about earth temperatures from a variety of sources: pollen, tree rings, sediments and so on. Scientists call this type of information "proxy" data since they provide only inferences, not direct measurements of temperature.

Hengeveld urges some caution in using ice core and proxy data but adds, "In a relative sense the evidence is quite clear. You have lower temperatures with lower carbon dioxide levels and higher temperatures with higher carbon dioxide levels."

Unfortunately, scientists have little to say about the cause and effect relationships between carbon dioxide levels and temperature change under natural conditions. One scientist has called it a "chicken and egg dilemma." The problem is that no one has been able to sort out all the factors (called climate "forcings") that can act to change the climate system.

To give us some idea about the possible effects of a global warming, studies have been done of other warmer periods in the planet's history. Scientists doing this work assume that the atmosphere will respond the same way, no matter what "forcing" mechanism is responsible for adding heat to the lower atmosphere.

A most intriguing "warm earth analogue" is the Climatic Optimum, the warmest period of the present interglacial, which occurred about 5,000 to 9,000 years ago. This period was one to two degrees warmer than now — about the same temperature rise we could expect with present levels of greenhouse gases. Studies of the Climatic Optimum show that large shifts in dryness and wetness patterns were associated even with this minimal temperature change.

Similar studies in historical times have produced information that broadly agrees with the Climatic Optimum studies. They show a drier North American heartland, with the south and west of the continent becoming wetter.

Not all scientists agree with the assumptions of warm earth studies. As Stephen Schneider of the U.S. Center for Atmospheric Research points out, we really don't know if human-induced carbon dioxide warming will produce the same patterns of regional temperature and precipitation as natural climate variation. But it is possible that the warm earth studies could give us some idea of conditions at the beginning of a greenhouse warming.

Computer models are increasingly being relied on for information on the magnitude and impacts of the greenhouse effect. They have provided us with predictions of how much temperatures would rise if carbon dioxide levels were doubled, and with estimates of the effects of other trace greenhouse gases. They have also been used to predict changes in the amount of global precipitation with increasing carbon dioxide.

The most controversial modelling experiments are those that try to assess regional responses to greenhouse warming. So far, computer models have produced few consistent scenarios of local change with increased carbon dioxide. Unfortunately, it is just this level of information that is important to the average citizen and planners. So why support the use of these models for making predictions?

Computer simulations of climate change caused by carbon dioxide have been made with a hierarchy of models. The simpler models calculate the earth's surface temperature, or the temperature in a vertical column of atmosphere. These models are based on a large number of assumptions and do not include many aspects of the climate system.

The most sophisticated computer climate models used for greenhouse warming experiments are general circulation models. These models are offspring of weather forecasting models first developed in the 1950s. According to Dr. Schlesinger, no other model can handle the complexity of global climate change.

General circulation models use mathematical equations developed to describe the physical laws of the atmosphere. Modellers divide the atmosphere vertically and horizontally to make cubes, and calculate the climate in the centre of each cube.

These models are used to simulate current climate and then to predict the effects of different factors affecting climate such as carbon dioxide doubling. Most model simulations have been attempted to find the new climate equilibrium which would exist with twice as much CO_2, without asking how the climate would evolve between current and future states.

More recently, modellers have started running experiments to simulate the effects of a gradual increase of carbon dioxide and trace gases (the situation that is actually occurring).

''It's fair to say that general circulation models do a reasonable job of simulating current climate. It depends on what you call reasonable,'' says George Boer, a modeller with the Canadian Climate Centre.

Canada is developing its own general circulation model which is considered a ''state-of-the-art'' model. It has been used for studies of climate change related to the recent El Niño, and scientists started running a carbon dioxide experiment with it this summer.

Dr. Boer readily admits general circulation models have their problems. The models are based on the physics of the atmosphere, but all of the details are not perfectly known. Nor is there a clear understanding of all of the factors that could cause climate change in addition to increased CO_2 — such as solar radiation, volcanic activity, or dust put into the atmosphere from human activities.

Michael Schlesinger thinks the high temperatures of the 1980s could be blamed on El Niño.

The ocean acts as a sink for both carbon dioxide and heat. But ocean circulation models available to plug into general circulation models are both expensive and in a state of evolution. The ideal is a ''full-ocean model'' which models the ocean to its bottom and includes both vertical and horizontal movement of heat. Currently, for CO_2 questions most general circulation models rely on a model of the ocean only 65 metres deep with no horizontal movement.

Dr. Hansen suggests cirrus clouds may increase in a warming climate and enhance the greenhouse effect by reflecting heat back to the earth. But the effect of clouds is not included in today's models.

Scientists also lack observational data needed to validate their simulations of present climate. For instance, information on air temperatures over southern oceans remains sparse.

Modellers are also limited by a lack of computer power. The climate system includes many different interactions — between the atmosphere and ocean, the atmosphere and land, and so on. But some climate processes are ''small scale''; they act on a local level. The grid cells of the average general circulation model are too large to incorporate these processes. (A grid cell may be 400 kilometres a side.) To increase the resolution of the grid cells by a factor of 10 (i.e., a grid cell with a 40-kilometre side) would require a computer one thousand times faster than we have now.

To get around this problem, modellers have assumed that small-scale processes are the slaves of large-scale processes. Says Dr. Schlesinger, ''If they behave independently, we're dead; we can't predict climate.''

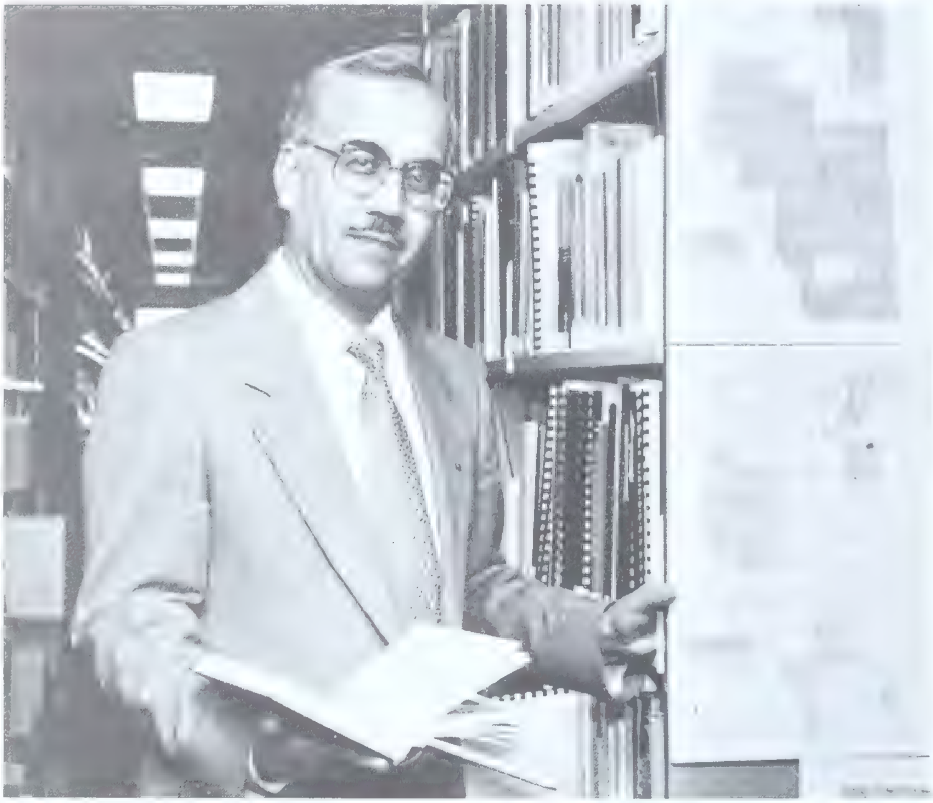
GOVERNMENT OF ALBERTA

A shift of only one or two degrees can mean a lot less snow in the winter.

Adjusting for these factors is the art of modelling. And the different ways modellers deal with the small-scale processes are what produce different results from model experiments.

Recently, Canadian scientists compared the results of three general circulation models with respect to changes over Canada for doubled carbon dioxide. The models all agreed that Canada would get warmer in all regions. But the amount of warming and changes in rainfall patterns were very different, particularly for the Arctic.

In another series of experiments, a change in the way cloud was handled moved the location of maximum temperature increase from eastern Canada to central Manitoba.



Dr. Harby Sandhu

For Dr. Boer, these discrepancies only underline the importance of having several working models. When modellers can discriminate among alternative model results, they will have greater success in predicting future climate.

There are many areas where modellers do agree, however, and it is on the basis of these results that scientists have begun to sound the alarm about greenhouse warming.

The modellers agree on the range of temperature increase we can expect at current emission rates for carbon dioxide and trace gases. All models show warming virtually everywhere in both summer and winter if carbon dioxide is doubled.

They agree that temperature changes at high latitudes will be greater than those at lower latitudes, and especially for areas of sea ice. (The resulting melting of polar ice will significantly alter sea levels.)

Most modellers also agree that mid-latitude areas (such as Alberta) will become drier as storm tracks are pushed north. They say we can expect to see more droughts, and more severe droughts in these areas.

> *"When severe drought becomes a one-in-10-year phenomenon instead of a one-in-50, how will farmers survive?"*

Harby Sandhu is senior manager with Alberta Environment, chairman of the province's Climate Advisory Committee, and a member of the Canadian Climate Program Planning Board. He says it is the extreme events that are most dangerous to the biosphere: tornadoes and heat waves, for example.

Some scientists consider 1988 to have been a "dry run" of what we can expect more frequently in the future. As Henry Hengeveld asks, "When severe drought becomes a one-in-10-year phenomenon instead of a one-in-50, how will farmers survive?"

How well society does in the face of greenhouse warming will depend on its ability to act quickly and with flexibility. But it also depends on having good data.

"If we are to bring climate change information into the planning of future resource use, it is important that we have model predictions that are relatively sound," says Dr. Sandhu.

But forecasters of impacts from global warming are faced with the fact that models cannot yet provide us with regional information and good data on such important factors as rainfall. Are there alternatives to using these models?

"I can't see what they would be," says Dr. Boer. "There are few alternatives to the power and consistency of this approach." He sees the models as the "only foreseeable method" for getting the information we need.

Recently, Dr. Schlesinger has been promoting the development of intermediate or "mesoscale" models that could be incorporated into general circulation models. These are models with grid squares of relatively fine resolution (e.g., 50 kilometres a side) for selected geographic areas.

He plans to run an experiment with a mesoscale model included in his general circulation model. It will take 12,000 hours to run and cost up to $24 million (U.S.) for computer time alone.

New computer technology expected in the next decade will also enhance scientists' ability to fine-tune their models.

Research must continue. There is an urgent need for global measurements to improve what we know about climate forcing factors and climate feedback systems.

"We will never be able to simulate nature as a mathematical model," says Dr. Schlesinger. But refinements can be made. Comparing computer simulations with warm earth analogues and historical data can considerably improve our ability to predict local effects.

"An assessment of the current general circulation models is needed to find out their limitations and strengths for application to Alberta," says Dr. Sandhu. "We can't wait for these models to be perfected; we must use whatever we have available. The 1988 world conference on *The Changing Atmosphere* has provided enough scientific consensus on this issue. The time for the global community to take some action is now."

And, says Dr. Schlesinger, "We don't have a whole lot of time left."

R. Edrea Daniel is an Edmonton freelance writer.

Shirley Serviss

THE CHANGING ATMOSPHERE –
What Should We Do About It?

Action that can be taken to minimize the damage

GOVERNMENT OF ALBERTA

"Whatever will be, will be — the future's not ours to see," is a familiar song and a common attitude. But scientists are trying to force us to look into that crystal ball (or computer model as the case may be) and face up to the fact that major climate changes could make the future very much different than anything we ever imagined.

There is growing concern about the threats posed to the atmosphere by such things as the greenhouse effect, depletion of the ozone layer, acid rain, urban smog, arctic haze and toxic chemicals. Policy makers and scientists have convened a number of international conferences searching for solutions.

Kenneth Hare, climatologist and chairman of Canada's Climate Program Planning Board as well as chancellor of Trent University, believes that it's an issue that's taken hold — mostly in North America, Europe and the Soviet Union.

"Third World countries have much more immediate problems and take the attitude, rightfully so, that this is a problem we created so we are the ones who have to do something about it," Dr. Hare comments.

Action on some fronts has already been taken. The Montreal Protocol — an international treaty to control substances that deplete the ozone layer — will come into effect this January. It establishes phase-down requirements to reduce emissions, includes incentives to help prevent developing countries from re-creating the problem in the future and provides for trade sanctions against countries that refuse to sign or abide by the agreement.

Canada has a relatively small chlorofluorocarbon (CFC) industry — not enough to make a significant difference to the ozone layer, according to Jean Carbonneau, a regulation engineer in the commercial chemicals branch of Environment Canada. However, "pollution is a global problem and requires a global solution," he notes. Environment Canada will be controlling CFC production, imports, use and exports in accordance with the Montreal Protocol and is also looking at imposing further regulations to include other chemicals.

> *"Third World countries have much more immediate problems... so we are the ones who have to do something about it."*

There are other strategies that could be pursued. These include replacing the ozone-depleting CFCs with alternative chemicals, developing alternative technology such as helium-based refrigeration systems and encouraging the use of alternative products. As individuals, we can buy fibreglass insulation rather than polyurethane foam or use deodorant sticks rather than aerosol sprays. Cardboard egg cartons are a better choice than foamed-plastic containers.

Canada may not be contributing significantly to ozone depletion, but we are one

Burning releases carbon into the atmosphere.

> *"Canada is not doing as much as it could do in terms of developing or implementing new technology."*

of the highest carbon producers per capita in the world, according to Philip Jessup, director of air quality research for Energy Probe (a national energy and environment think tank and action group).

He thinks Canada can do a number of things to reduce emissions of carbon dioxide (CO_2). For example, he believes we can meet future needs for energy by conservation rather than by building more coal-fired power plants. He also thinks we should be converting power-supply systems from coal to natural gas (which produces half the amount of CO_2) and energy-generation systems that are more efficient.

"Canada is not doing as much as it could do in terms of developing or implementing new technology," he says.

Jessup mentioned MHD technology (magneto-hydro dynamics) as one example of what could be done. It is a process for extracting energy from coal with a 60 per cent efficiency (instead of 30 per cent) – which would mean a 50 per cent reduction in CO_2 emissions. He also referred to co-generation technology which uses a single source of energy to produce both heat and electricity.

"We tend to think in terms of mega-projects and centralized supply rather than decentralized power generation or co-generation," Jessup says. Nuclear power is another option, although it may be politically infeasible.

In Canada in 1985, 29 per cent of CO_2 emissions came from automobiles. Jessup believes we need to impose mandatory fuel-efficiency standards and tax fossil fuels on the amount of carbon in them. This would raise money (which could be used for energy efficiency programs) and raise prices. "People tend to conserve more if it saves them money," he says.

According to Jessup, Canadian industry uses, on average, five times as much energy as the Japanese to manufacture a given product. "We need to find ways to make our industries more energy efficient and need policies to encourage energy conservation."

Dr. Hare agrees that Canada would profit from an "all-out second round of energy conservation measures" such as insulation programs and reduction in the size of cars. "Our first line of defence has to be conservation and efficient use of energy," he says.

Alberta Energy's energy conservation branch is evaluating its existing activities in light of concerns identified at *The Changing Atmosphere* held in Toronto in June.

Director Ian Burn believes the target set at that conference for a 20 per cent reduction in CO_2 emissions by the year 2005 is "within the realm of possibilities."

Fibreglass insulation is more environmentally-friendly than polyurethane foam.

A recent paper prepared for the Alberta Conservation Strategy project shows that Albertans could save more than $700 million a year by conserving energy. The other benefit would be a reduction in CO_2 emissions of 15 million tonnes per year.

"These savings are practical targets that could be reached within a few years," he says.

Many of the actions needed to help prevent excessive climate change are actions that are equally sound for other reasons. Energy efficiency saves money. Reforestation provides ground cover to prevent erosion and protect watersheds.

Deforestation contributes to the buildup of atmospheric CO_2 and other greenhouse gases both by reducing the stock of forests that absorb CO_2 and by increasing emissions through burning. Therefore, steps to reduce deforestation and increase the expansion of forested area must be part of the broad climate change solution.

Dr. John Drew, director of the reforestation and reclamation branch of the Alberta Forest Service believes forestry has a significant role to play in correcting part of the problem. However, he says for the world to put pressure on the Brazilian government to stop development in the rain forest is asking too much.

"I don't think the final resolution is not developing the Amazon rain forests or setting aside more Canadian forest in our wilderness area. I think the solution is to ensure we have healthy, vigorous forests in sufficient quantity," he says.

He believes in proceeding with development, but with a strong regeneration and environmental component. Improved forest management is needed throughout the world.

Alberta is doing its bit, according to Dr. Drew. "In Alberta, everything we've logged is regenerated so we are sustaining that balance." Ten years after an area is logged, it has to be stocked at an 80 per cent level which translates to a minimum of 800 trees/hectare. Our success at reaching that is currently 96 per cent, he notes.

"The fact that there are more pulp mills underway or planned may seem to be a conflict, but it causes us to take existing forests and convert them into more healthy forests with a better balance of trees of different ages." This solution is more complex, but more realistic, he believes.

Teja Singh, research scientist and biometrician at the Canadian Forestry Service's Northern Forestry Centre, cautions that because of the global warming, the boreal forests could recede. Farther north, soil conditions are a limiting factor.

Kenneth Higginbotham, director of the forest research branch of the Alberta Forest Service, points out that plant species have certain ranges in temperature and precipitation that they can withstand. And we do not know about the effects of ultraviolet-B radiation (UV-B) on our forests. "We may see a shift in the kind of species we use," he predicts.

In fact, Ross Wein, director of the Boreal Institute for Northern Studies at the University of Alberta, says research in these areas is beginning. A group of scientists at the U of A is studying the interaction of high CO_2 levels and UV-B radiation to determine which species would grow more successfully under this type of environment. Also being studied is the genetic makeup of species of trees which might be able to withstand warmer and dryer conditions and which species can best interact with the anticipated encroachment of grasslands.

Some merchants have never made the switch to plastics. At Edmonton's Acme Meat Market, the butcher uses brown paper and string, just as his grandfather did.

"If we don't understand the problem, it's pretty hard to find solutions and at the present it's just predictions and hypotheses," he says. "I'm trying to promote the idea we should try to learn more about the problem, develop a range of solutions and test them."

A sympathetic and alert government is needed in every province, according to Dr. Hare. Its role is not just to regulate, but to inform and to make sure research is done. However, he doesn't think the onus is entirely on government and believes that, as people see the scientific predictions coming about, they will make changes.

"Utilities, car manufacturers, farmers and ordinary citizens will adapt. They will switch into other forms of agriculture, look at other sources of power, buy different products. Farmers aren't going to sit by and watch their livelihood go down the tubes," he says.

Mohawk Oil is a prime example of an industry that is gearing up for change. Mohawk is selling a fuel that is 10 per cent ethanol. Alan Scarth, a Manitoba lawyer and director of Mohawk, calls it "the future fuel because it is environmentally friendly."

Ethanol is unlike gasoline, which comes from petroleum, as it is the product of distillation of plant products (grains). It is cleaner burning and the carbon given off is picked up by plants.

Mohawk is also one of the founders of Partnership for Sustainable Development, a joint effort of science and industry to study climate change. This group of American Great Plains industries — which includes grain companies, a major bank, a railway, and various consumer and retail operations — is gathering the expertise of world scientists and putting together a series of computer models of the Great Plains to produce predictions for the effects of climate change.

Environmentally Friendly Products

Consumers who care about the environment will no longer have to read the small print to find environmentally friendly products. By January, you should start to see labels identifying products which are recyclable, biodegradable, free of ozone-depleting gases or made from recycled materials.

"This is one way Canadians can translate their environmental concerns into consumer power and influence the marketplace to produce safer goods," comments Gordon Harris, communications advisor for Environment Canada Conservation and Protection.

Canadians have never been more concerned about environmental issues as they are now, according to Harris. The Environmentally Friendly program was initiated by Environment Canada in response to that interest.

"Surveys show that Canadians are prepared to pay more for 'environmentally-friendly' products, but they must be able to easily identify those products," Harris says.

An advisory panel was established this fall to determine product categories, establish criteria and accept applications from industry. Products will be tested by the Canadian Standards Association (CSA) and evaluated to see if they merit the environmental seal of approval.

Although start-up costs will be borne by the government, the system will ultimately be self-sustaining. Applicants will pay fees to have their products and processes evaluated. Manufacturers, producers, packagers and retailers have expressed interest and support for this campaign.

— Shirley Serviss

Adopt-a-Rainforest

When scientists say that the destruction of tropical rainforests could cause climate change, they are thinking of the greenhouse effect. All plants use carbon dioxide during photosynthesis -- rainforests use an especially large amount because they are so productive. Removing them removes an important "CO_2 sink" and has the same effect as adding CO_2 to the atmosphere. Through slash and burn clearing, rainforest destruction directly adds large amounts of CO_2.

Tropical rainforests are also habitat for two-thirds of the plant and animal species on earth. Their preservation is essential to maintaining the biological diversity of the planet.

Every minute, however, another 50 acres of rainforest is destroyed. The World Wildlife Fund (WWF) Canada started the Guardian of the Rainforest program this year to help preserve what's left. For $25, you can become a "Guardian" and protect an acre of rainforest in Mexico or Guatemala forever. Last year, thousands of Canadians helped WWF Canada raise $500,000 to buy the security of 20,000 acres of the Monteverde Cloud Forest in Costa Rica, and a donation of the Jaguar Car Company established the world's first jaguar preserve in the rainforests of Belize.

If you want to become a Guardian of the Rainforest, send your donation to the World Wildlife Fund, Suite 201, 60 St. Clair Ave. East, Toronto, Ontario M4T 1N5, or call 1-416-923-8173.

— Shirley Serviss

Dr. Ross Wein

"What this partnership is concentrating on is the anticipated result of the climate change. We have to know the result before we can determine a cure," Scarth says.

But are we interested enough and concerned enough to do anything? Does the average person actually lose any sleep over depletion of the ozone layer? Are our politicians merely paying attention to the problem as part of their bid to get elected?

Part of the problem is that predicted climate change is so intangible that it's a hard issue to sell to tax payers or shareholders. "No matter what action we take now, we won't see results for 30 to 100 years," regulation-engineer Carbonneau says.

"Qué será, será, whatever will be, will be" may be our preferred approach to life, but nevertheless, many of us do invest capital in our retirement plans or funds for our children's education. Conversion to less-polluting fuels, research into more efficient technology and alternate types of forestry and agriculture, construction of sea walls, dikes and drainage systems are equally long-term investments — in the future of our environment.

Shirley Serviss is an Edmonton freelance writer.

LETTERS

Dear Editor,

Your issue on Tourism and the Environment was very interesting and timely as well. At the recent Alberta Conservation and Reclamation Conference '88, sponsored by the Alberta chapters of the Canadian Land Reclamation Association and the Soil and Water Conservation Society, I presented a paper on reclamation of Alberta's highways. The general thrust of the paper was that we could do a lot to beautify our highway rights-of-way by reducing mowing (so they don't look like football fields) and by planting trees and shrubs.

I closed by asking a simple question. If Alberta is "Wild Rose Country," why is it that tourists, and indeed many Albertans, will never see a wild rose on their highway travels except on the license plate in front of them? Surely a wild rose planting program would do much to enhance our highways and to make tourists more aware of our provincial flower.

Yours truly, C.B. Powter
President
Canadian Land Reclamation Association

Dear Editor,

"For the care and maintenance of the well-being of one species of animal, i.e. man, Health and Welfare Canada spends $33 billion annually. For all others that contribute to man's existence, i.e. other animals, plants, soil, atmosphere, etc. Environment Canada spends $422 million annually. This works out to a ratio of man:environment as 80:1. Similar figures for Alberta work out to 17:1. That is, equating man's existence to money spent by the two departments, the federal government feels mankind is 80 times, and the Alberta government 17 times, more important than the environment.

No wonder mankind has abused the earth's environment for so long and treated it so matter of fact and shabbily that it is now attempting to send mankind to join the dinosaurs. It appears the only solution left for man to save himself from extinction is to at least give the environment equal status in the scheme of nature's bounty (in fact, it needs a complete reversal of roles, like 1:80) as man has given himself at its expense. In short, isn't it time all three levels of government spent more money on the earth's environment, and less on military and energy mega-projects?

Yours very sincerely,
Susiri C Wanigaratne, Edmonton

Think Recycle

Environment-conscious Edmonton residents now have an opportunity to participate in a city-wide recycling program.

Canada's largest curb-side recycling program began on October 24. By December 2, all residents with individual garbage collection will have received blue containers. Homeowners have been asked to separate newspapers, cans, glass bottles and jars from their garbage and set out their blue boxes on the same day as their regular garbage pick-up.

More items will be added as soon as markets for them can be established. Participants will be asked to collect plastic containers next April, and the city is hoping to find markets for magazines, cardboard, wood and textiles.

"If we can find a market for something, we'll collect it," reports Bonnie Kulak of the City of Edmonton's water and sanitation department.

As the program develops, residents of multiple-housing units and businesses will also be asked to participate. "Commercial businesses are a key area as they account for 70 per cent of what goes into our landfill sites," Kulak reports.

The recycling contract was awarded to two private companies — the Edmonton Recycling Society in north Edmonton and Browning-Ferris Industries (BFI Waste Systems) in the south.

The Edmonton Recycling Society is a community-based association and is anxious to involve charitable organizations who have traditionally made money through bottle drives in its operations. Some groups have been preparing the blue boxes for distribution. Others will be helping sort the items that come in for recycling.

The city encourages to continue to support these organizations. "We're all in the same business," notes Edmonton Recycling Society Executive Director Cornelius Guenter.

Concern has been expressed about the city's recycling program interfering with the livelihood of back-alley bottle pickers, but Guenter invites any such scavenger to "cash in his Safeway cart and come work with us — it's warmer here."

Edmonton's recycling program is a small step, but a very important one toward developing an overall waste management plan for the city, according to Kulak. "We have to start now in taking a more responsible approach to garbage disposal," she says. "Burying garbage in landfills is not a long-term, environmentally-acceptable solution."

Recycling can reduce residential waste by up to 10 per cent and extend the life of the landfill. Useful material can be recovered and reused.

"We live on a limited planet and can no longer afford to squander our land and natural resources," Kulak says.

The recycling program was implemented following a one-year pilot project funded by the City of Edmonton and Alberta Environment. Newsprint, household metal and glassware were collected in the communities of Riverbend, Rosslyn and Clareview/Hermitage. About 70 per cent of the homeowners in these communities agreed to participate. This number rose slightly as the program progressed.

It is too early to determine participation rates in the city-wide program, but it is expected to be as high. Calls received by the water and sanitation department are running nine to one in favour of recycling, Kulak reports.

Expansion of the program has been welcomed by at least one city resident who has been saving newspapers, cans and jars in anticipation. "It feels good to be able to do something constructive that really helps the environment," says Duggan homeowner Marilyn Allison. "It doesn't take a lot of time to rinse out cans and jars and it makes me feel as though I'm contributing — not wasting."

Good news for Canadian Wood Bison

In 1957, there were only 200 wood bison in Canada and the animal was later declared an endangered species by the Committee on the Status of Endangered Wildlife in Canada.

Today, there are about 2,500 wood bison in the world — most of them in Canada — and back in June, delighted conservationists announced the wood bison has been removed from the endangered category.

Most, if not all, of the credit goes to a bison recovery program started in 1960. The Alberta government has been involved since 1983. Manitoba, British Columbia, the Yukon and the Northwest Territories and the Canadian Wildlife Service are the other members of the recovery team.

Earlier attempts to save the shaggy beast, which is the larger, darker and woollier cousin of the more plentiful plains bison, did more harm than good. Wood Buffalo National Park was established on the Alberta-Northwest Territories border in 1922, with an estimated 1,500 to 2,000 wood bison taking up residence. But between 1925 and 1928, more than 6,000 plains bison were introduced to the park, to relieve pressure at the overcrowded Wainwright Buffalo Park.

The newcomers introduced disease and the two subspecies interbred.

"By 1940, it was felt the pure wood bison was extinct," says Hal Reynolds, wildlife biologist with the Canadian Wildlife Service of Environment Canada and project leader of the wood bison rehabilitation program.

But the finding of the 200-strong herd in the Northwest Territories prompted efforts to save them and increase their numbers. Between 1963 and 1965, 18 of the bison were moved to the McKenzie Bison Sanctuary and another 24 to Elk Island National Park. They now number about 2,000, Reynolds said.

Three other herds were marked for introduction to the wild. About 15 animals were released June 10 in the Inter-Lake region of Manitoba. Another 23 were set free in March in the Nisling River Valley in the Yukon.

Plans to release wood bison from the Hay-Zamra Lakes area near Assumption have been put on hold indefinitely until the issue of disease has been settled, said Bob McFetridge, provincial manager of regional wildlife for the Peace River region.

Despite the rise in population, the wood bison isn't entirely home free. It has not been removed from the committee's list of wildlife in trouble, but rather, has been moved down a notch to the less-serious position of "threatened."

(The list starts with rare, proceeds to threatened, endangered, extirpated — meaning it no longer exists in Canada but is found elsewhere in the world — and then to extinct.)

Reynolds said complete removal from the list could be "in five years, at the earliest, if everything works out right."

For this to happen, there should be at least four geographically separated and publicly-controlled populations of at least 200 or of equal viability, with roughly a 50-50 sex ratio.

Boosting the wood bison's numbers has been a lengthy and expensive process, he says.

"The key to preventing further problems is habitat preservation. There should be early detection of animals that might be in trouble, to determine if there is a problem and why."

Sometimes the culprit is over-hunting, "but it almost always comes back to habitat," Reynolds says.

Wildlife Under Scrutiny

The question of captive wildlife — animals living in zoos, game farms and the like — is one area to be examined by a task force addressing amendments to existing guidelines for Canada's wildlife policy.

Native views will also get greater attention when changes to the existing five-year-old policy are being considered, says Gordon Kerr, director of the western and northern region of the Canadian Wildlife Service.

The task force, made up of federal, provincial and non-government organizations, will look over workshop summaries from a three-day federal-provincial wildlife conference, held in Victoria in June. It will then propose amendments to be brought before next year's conference.

"I think we will see moves in the area of humane treatment of wildlife generally," Kerr predicted in discussing future policy.

The Victoria conference was unique in that the thrust of it was to question whether wildlife management is moving in the right direction, Kerr says, calling it a "kind of soul-searching, futuristic program."

The existing wildlife policy was developed primarily by government agencies, he says, but the tables have turned, "and now it's become a total public input."

Natural history and wildlife groups, various forestry and agricultural land use groups and several petroleum industry representatives are on the task force.

Around the Province was prepared this issue by Cathie Bartlett and Shirley Serviss, both Edmonton freelance writers.

BOOK REVIEW

by David Spalding

Life in the Balance.

Companion to the Audubon Television Specials. David Rains Wallace. Harcourt Brace Jovanovich. 1987. 309p. $39.95.

The Hole in the Sky.

Man's Threat to the Ozone Layer.

John Gribbin. Bantam Books. 1988. 192p. $5.50.

Increasingly, the book is now the handmaiden to the TV series, providing what the communication engineers call media reinforcement — the support of a message in one medium with the same information in another. **Life in the Balance** is a fine example of the "book of the film" which proves how successful this approach can be. As may be expected, the visuals are important, and generally excellent, but the meat of this book is in the text. It tells a strong story of nature conservation from the perspective of the Audubon Society, one of the major forces in conservation in the U.S.A. An introductory chapter presenting a sketchy history of conservation, and a closing overview of tomorrow's wildlife frame an ecologically structured text. Each deals with a broad ecological zone such as the grasslands, forests and mountains. (The only major omission is the wildlife of strongly man-modified habitats — the situation in which most of us encounter nature.)

A typical chapter presents a story of a particular endangered species or habitat, (often presented in boxes apart from the main text), while describing the nature and origin of the habitat, the ways in which it has been historically used and modified by man, and the problems that are currently being faced.

The tone is that of the Audubon Society itself — caring, reactive and aggressive. The Society's reports on endangered species and habitats, and its court actions to protect key areas and species, are all used to provide useful data. Traditional and radical new methods of conservation are presented, but there is no discussion of the ethical issues involved in the survival of wild species through captive breeding, transplants and genetic manipulation. There is little sign of the "new conservation," in which society is slowly moving from a reactive to a proactive position, as in the development of conservation strategies. The book is a balanced, broadly based and enjoyable survey of a vitally important topic.

As with most American books, the Canadian story is treated peripherally. Yet, by reading between the lines, an interesting Canadian story emerges — that of Canadian conservation from a U.S. perspective. Canada provides a reservoir of wildlife such as grizzlies and wolves — almost extinct in the U.S. — to keep the U.S. reserves stocked. Canada's failures such as the harp seals are mentioned, but one would not guess from this text that the Canadian Wildlife Service had played a key role in the whooping crane successes. The unfortunate effects of small power dams in New England are described, but there is no discussion of the export of these problems to Canada by U.S. purchases of power from James Bay. There is a strong need for a Canadian book with the same breadth — but who in Canada has the financial muscle to fund it? And would it be read in the U.S. as this one will be here?

The writing varies from competent to brilliant. The colorful, fast-moving text deals with a great range of topics with assurance, flow and only occasional slips. The use of some technical language may be a problem to some readers. No glossary is supplied and there are no references to further information.

The Hole in the Sky presents the sort of doomsday scenario familiar in science fiction stories. Does this plot sound familiar? A hitherto unsuspected threat to the Earth is recognized by only a few scientists; the industrial establishment is against it, and politicians react slowly and inadequately. Depressingly, there is no indication that this story is either fiction, or exaggerated to make a fast buck. Unfortunately, the broad thesis fits in with the way we have come to understand the world in the last 50 years — not just the potential dangers lurking, but the predictable reactions of industrial and political establishments.

The book presents a readable and credible account of the scientific evidence for the depletion of the ozone layer.

More important than the style is the message. The greenhouse effect is already with us, and the ozone layer is being rapidly and seriously depleted. The science is fairly certain, though prediction of future effects is of course controversial; the system is fragile, subtle, and may be triggered into a non-linear effect by means we do not as yet understand. Industry is trying hard to protect its interests, by asking for further studies, accepting limitations that do not prevent exports, and (in some enlightened instances) planning to profit from the development and use of less dangerous substitute chemicals.

Unfortunately, the book seems to take for granted that once scientists have pointed out a problem, there is nothing to stop the world taking action but the short-sightedness of politicians. There is only brief discussion of the enormous problems of reaching international accord when there are so many vested interests. If we can't outlaw nuclear war when the results are undisputed and immediate, how can the countries of the world deal with a more nebulous threat such as ozone depletion? The greenhouse effect was pointed out at the end of the last century — if it takes us as long to deal with ozone depletion we will all find out only too soon what the effects are.

Will mankind survive? Read this book, and then watch tonight's news to find out.

David Spalding, an Edmonton freelance writer and heritage consultant, is vice-president of Kanata Heritage Research & Presentation Corporation.

If undelivered, return to:

Environment Views
Alberta Environment
9820 - 106 Street
Edmonton, Alberta T5K 2J6

ENVIRONMENT UPDATE

Wetlands, Wildlife and Agriculture

A conference entitled *Wetlands, Wildlife and Agriculture* will be jointly sponsored by the Alberta branches of the Canadian Water Resources Association and by the Soil and Water Conservation Society. This conference is a follow-up to one held last April in Edmonton which identified problems, and will focus on solutions to conflicts in this area.

February 15-17, Edmonton. For registration or further information contact Lynne Kemper 422-4232 or Anne Naeth 432-5338.

New Sulphur Recovery Requirements

Tougher sulphur recovery requirements implemented this fall will reduce sulphur emissions from new sour gas processing plants in Alberta. The changes will also promote the development and use of new sulphur recovery technologies.

Major sour gas plants — processing in excess of 10 tonnes of sulphur each day — had been required to recover sulphur in percentages ranging from 94.5 to 99 per cent, depending on the size of each facility. New plants must now recover from 96.2 to 99.8 per cent.

Under the old guidelines, plants processing less than 10 tonnes per day had been permitted to emit sulphur to the atmosphere as sulphur dioxide by burning it in flare stacks. Under the new requirements, only plants processing less than one tonne per day will be approved without sulphur recovery.

New plants processing one to five tonnes per day are now required to recover at least 70 per cent of the sulphur coming into the plant. New plants processing from five to 10 tonnes per day are required to recover 90 per cent of their sulphur.

The new sulphur recovery requirements are consistent with Alberta's long-range objective of reducing air pollution, said Environment minister Ian Reid.

Oldman River Dam Forum

The proceedings of the University of Lethbridge Oldman River Dam Forum, held in March 1988, are now available. This publication is of special interest as it contains the thoughts of many authorities on a range of topics regarding the controversial Oldman River Dam project.

The report entitled *Economic, Environmental and Social Aspects of the Oldman River Dam Project* can be ordered from the:

Department of Biology
University of Lethbridge
4401 University Dr.
Lethbridge, Alta.
T1K 3M4

$20, mail orders $22.

Composting Trial for Edmonton

As much as 40 per cent of Edmonton's solid waste stream could be recycled through composting. The technology exists, but is it feasible?

Water and Sanitation hopes to find answers to that question with a pilot composting operation. The department is now calling for letters-of-interest and pre-qualification from companies wishing to submit proposals for constructing and operating a pilot plant.

For further information, contact Bonnie Kulak at 428-2722.

Bicycle Parking Study

As a cyclist, are you frustrated with the lack of adequate bicycle parking facilities? As a business owner or government agency, would you like to install quality bike racks but don't know where to find them? Then you need the report: *Bicycle Parking: The Good, The Bad, and The Ugly,* available for $2 postpaid from the Edmonton Bicycle Commuters, 10701 - 85 Avenue, Edmonton T6E 2K9, or phone 433-BIKE(2453).

Seeking Consensus: The Public's Role in Environmental Decision-Making

This was the theme of the 1988 symposium sponsored by the CSEB, Alberta Chapter and the Alberta Society of Professional Biologists for which proceedings are now available, featuring 14 papers, a panel discussion, and a conference commentary. Copies of the 115-page proceedings are $12.00. Please send a cheque or money order to:

1988 Proceedings
CSEB, Alberta Chapter
Box 12, Substation 11
Edmonton, Alberta
T6G 2E0

If you have a short news item of province-wide interest you'd like to contribute to Environment Update, please send it to the editor at the address on the Contents page. The editor reserves the right to select and edit the items.